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BALZER (A. I.). **Insect Pests of stored Rice and their Control.**—*Fmrs' Bull. U.S. Dep. Agric.* no. 1906, 22 pp., 16 figs., 1 ref. Washington, D.C., 1942.

The losses caused by insects to stored rice in the United States are estimated at over 3 million dollars a year or 10 per cent. of the total value of the crop. Some 30 species have been found infesting stored rice and rice products, but only a few are a serious menace to rice that is in good condition. The most destructive of those that infest rough rice (kernels enclosed in the hulls) are *Sitotroga cerealella*, Ol., and *Rhizopertha dominica*, F., which can enter the grain through the hull, and *Calandra* (*Sitophilus*) *oryzae*, L., which bores into grains with hulls that are broken or have failed to close properly after blooming. Several other species feed on the surface of the kernels, on broken grains, and on grains damaged by these borers. The commonest are *Tenebroides mauritanicus*, L., *Oryzaephilus surinamensis*, L., *Laemophloeus minutus*, Ol., *Plodia interpunctella*, Hb., and *Corcyra cephalonica*, Staint. The main pests of rice from which the hulls have been removed are *Calandra oryzae* and *R. dominica* (the only ones that bore into the kernels), *O. surinamensis*, *Tribolium castaneum*, Hbst., *T. confusum*, Duv., *Tenebroides mauritanicus*, *L. minutus*, *P. interpunctella*, *C. cephalonica*, *Carpophilus dimidiatus*, F., and Psocids. The sources of infestation of stored rice are reviewed, and the results of investigations on the reduction of field infestation by pests of stored rice are summarised [*cf. R.A.E.*, A **30** 170].

A satisfactory kill of insects in rough rice stored in covered wooden cribbed bins is obtained by introducing crude granular calcium cyanide (equivalent to 23–28 per cent. available hydrocyanic acid) into the grain stream as the bin is being filled. The rate required is 8 lb. per 360 bushels, and double the quantity for the first and last thousand bushels of the grain stream.

The buildings and machinery of mills and warehouses should be so arranged as to be readily cleaned. Tailings from rice cleaning machines usually contain many insects, and an effective method of destroying them is to allow the tailings to fall into a metal container and fumigate them overnight with a mixture of ethylene dichloride and carbon tetrachloride (3 : 1) at the rate of about 1·5 oz. per 100 lb. The insects can also be killed by the heat produced by infra-red rays, and a description is given of an apparatus in which the tailings are passed in a thin layer beneath a row of lamps.

The drying of moist rice and rice products reduces their susceptibility to insect damage, and exposure to heat destroys the pests. Ten minutes' exposure to 140°F. kills all insects that infest stored rice, but heating is unsatisfactory in practice since the quality of the rice may be affected and it heats very slowly. In experiments, exposure to hot-air blasts at 140°F. for 30 minutes raised the temperature of the rice to only 122°F., which was insufficient.

The fumigation of mills, warehouses and elevators, and of individual lots of rice and rice products is discussed in some detail, the methods and equipment are described and dosages for the various fumigants are given. Those used are liquid hydrocyanic acid and methyl bromide for all types of fumigation, a mixture of ethylene oxide and carbon dioxide (1 : 9) for vacuum chambers, and chloropicrin for atmospheric chambers and railway wagons. Dosages of methyl bromide effective for fumigating rice in different types of packages in atmospheric or vacuum chambers are shown in tables. Rough or milled rice stored in bags in suitable buildings can be fumigated with hydrocyanic acid gas applied through a piping system installed throughout the building with disk-type spray nozzles at the rate of one for each 10 to 15 thousand cu. ft. space, or with methyl bromide released from cylinders through copper tubing so that the liquid is ejected horizontally above the stacks or near the ceiling.

Contact sprays kill the insects that are thoroughly covered with them and are useful in empty warehouses. That recommended consists of 5 per cent. of an extract prepared by extracting 20 lb. pyrethrum flowers in 1 U.S. gal. solvent, in odourless kerosene.

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LOWENSTEIN (O.). **A Method of physiological Assay of Pyrethrum Extracts.**—*Nature* **150** no. 3817 pp. 760–762, 3 figs., 2 refs. London, 1942.

The author outlines a method of carrying out rapid preliminary tests of the relative effectiveness of pyrethrum preparations of various compositions and strengths, without the use of the extensive insect material necessary for the biological assay described by E. A. Parkin [*cf. R.A.E.*, A **31** 85]. It is based on the observation and recording of action potentials in the exposed abdominal nerve cord of *Blatta orientalis*, L., by means of a standard resistance capacity coupled amplifier in conjunction with an oscillograph or a loudspeaker, and was tested with a range of concentrations of 0·07–1·3 per cent. total pyrethrins in heavy oil. It appeared to be most sensitive between concentrations of 0·13 and 0·23 per cent. and showed rather poor discriminating power for concentrations above 0·33 per cent. For intact insects, a comparable critical range of concentrations seems to lie in the neighbourhood of 1·6 or 1·3 per cent. total pyrethrin content. It is thought that there is an approximate correspondence in toxic effect between a 1·6 per cent. pyrethrin solution applied externally and a 0·3 per cent. solution of the same composition applied directly to the exposed nervous system.

The advantages of this method, which, apart from its usefulness in qualitative tests, appears to be particularly suitable for the preliminary quantitative assay of relative toxicities, include the following : the test animals are easily obtainable and ten only are necessary for each test ; the exposure of the nervous system does not present any technical difficulty ; the sensitivity of the method is unexpectedly satisfactory ; acoustical diagnosis is sufficient to furnish a satisfactory end point at low amplification, rendering the use of an oscillograph and recording camera unnecessary ; and the experimental procedure for practical testing is sufficiently simple to be carried out in a routine way by any trained biologist.

BARBER (G. W.). **Mineral-oil Treatment of Sweet Corn for Earworm Control.**—*Circ. U.S. Dep. Agric.* no. 657, 15 pp., 6 figs. Washington, D.C., 1942.

This is a general discussion of the method of controlling *Heliothis armigera*, Hb., on sweet maize in the United States by injecting mineral oil, with or without the addition of pyrethrum extract or dichloroethyl ether, into the ears [*cf. R.A.E.*, A **30** 267, etc.]. When the oil alone is applied to the tips of the ears, it saturates the mass of silk that is enclosed by the husks and serves as a barrier. The small larvae that are already in the silks are killed, probably by being smothered, and small larvae that subsequently enter the silks also succumb or are repelled. The oil alone is not very effective against larger larvae, or if the husks are short or loose. The mixture with pyrethrum extract kills larvae of all sizes fairly quickly ; in this case the objective is not to establish a barrier, but to disperse the material so that it will come into contact with all the contained larvae. The effect of a mixture of oil and dichloroethyl ether is different from that of either oil alone or oil containing pyrethrins. Though the mixture kills some larvae by contact, the volatilising dichloroethyl ether acts as a fumigant against others, often reaching and killing larvae that have not been wetted by the mixture.

BAKER (W. A.), QUESTEL (D. D.) & BATCHELDER (C. H.). **Protecting Market Sweet Corn from the European Corn Borer.**—*Leaflet U.S. Dep. Agric.* no. 225, 7 pp., 4 figs. Washington, D.C., 1942.

Derris and cubé are the most effective insecticides in sprays and dusts against *Pyrausta nubilalis*, Hb., on sweet maize in the United States, but are not at present available in any quantity. Details are therefore given of the preparation and use of sprays containing phenothiazine or a tank mixture of nicotine

sulphate and bentonite with suitable proprietary spreaders; sprays of this type have proved fairly satisfactory in the eastern States, though less so in the Lake States [*cf.* *R.A.E.*, A **25** 769; **28** 176]. Dusts are less effective than sprays but are profitable on valuable crops in the eastern States. The best available one is a dual-fixed nicotine dust [**25** 770] containing 4 per cent. nicotine.

LEACH (J. G.) & MULLIN (J. R.). **The daily Flight of Aster Leafhoppers as determined by a Light Trap.**—*Proc. W. Va Acad. Sci.* **15** pp. 93–95, 2 figs., 4 refs. Morgantown, W. Va., 1942.

Evidence has recently been obtained that the " blue-stem " or " purple-top wilt " of potatoes, which has been prevalent in the northern and eastern United States for some ten years, may be caused by the eastern strain of the aster-yellows virus [*Chlorogenus callistephi* var. *vulgaris* of Holmes], which has a wide host-range and is transmitted by *Macrosteles divisus*, Uhl. It was at first thought that potato is not susceptible to it [*cf.* *R.A.E.*, A **19** 580; **29** 301], but it has been transmitted to potato in both field and greenhouse experiments, and the symptoms agree in nearly all essentials with those of purple-top. *M. divisus* feeds on potato in the field, but apparently does not breed on it, so that it must migrate to potato from other plants. It overwinters as an adult or as eggs in the leaves of cereals and wild grasses and is abundant in spring on cereals and weeds. To ascertain when it migrates to potato fields, light-traps were operated in West Virginia from 26th May to 15th August in 1939 and 1940. The results and the minimum daily temperatures are shown on graphs. There was some migration throughout the summer, but distinct peaks of flight occurred during periods of successive warm nights.

YOUNKIN (S. G.). **Purple-top Wilt of Potatoes caused by the Aster-yellows Virus.** (Abstract.)—*Phytopathology* **33** no. 1 p. 16. Lancaster, Pa., 1943.

Further evidence has been obtained [*cf.* preceding abstract] that the eastern strain of the aster-yellows virus [*Chlorogenus callistephi* var. *vulgaris* of Holmes] may cause purple-top wilt of potato. Extensive tests have shown that *Macrosteles divisus*, Uhl., transmits a strain of the aster-yellows virus from naturally infected *Ambrosia artemisifolia* to potato, the symptoms induced being typical of those in naturally infected plants. Preliminary experiments indicate that insect number may be a factor limiting transmission to potato. In tests with insect populations of which at least 95 per cent. of the individuals were infective, 10 insects per plant gave a significantly higher incidence of infection than 5, while 20 insects appeared to transmit the virus no more effectively than 10. Approximately 200 grafts were made on *Nicotiana rustica* using scions from potato plants of four varieties naturally infected with purple-top from 18 localities in New York and Pennsylvania. Virus transmission to *N. rustica* was obtained in 4 cases. The symptoms of these four recovered strains were identical on *N. rustica* but distinct from those induced by the strain from *Ambrosia*. On asters, all strains appeared similar.

PRICE (W. C.). **Effect of Site of Inoculation upon Severity of Curly Top in Tobacco.** (Abstract.)—*Phytopathology* **33** no. 1 pp. 10–11. Lancaster, Pa., 1943.

In experiments on the transmission of the virus of sugar-beet curly-top [*Chlorogenus eutetticola* of Holmes] to tobacco plants by *Eutettix tenellus*, Baker, plants infected by insects feeding on the terminal bud and adjacent

leaves invariably developed severe symptoms, but many of those infected by insects feeding on a single leaf or on a 2-inch section of stem well below the terminal bud developed only mild symptoms.

STARK jr. (F. L.). **Adsorption of Chloropicrin and other Fumigants by the Soil.** (Abstract.)—*Phytopathology* **33** no. 1 p. 12. Lancaster, Pa., 1943.

By means of a microbalance, the weight of chloropicrin and other soil fumigants adsorbed by soil particles was determined. The amount of gas adsorbed is dependent primarily on size of the soil particles, soil temperature, and concentration of gas. Heavy soils having a large clay fraction may adsorb chloropicrin up to 10 per cent. of their weight from a saturated atmosphere. Degree of aggregation of soil particles has little influence on either the quantity of gas adsorbed or rate of adsorption. Carbon bisulphide is taken up in smaller quantities than chloropicrin and at a much slower rate than either chloropicrin or formaldehyde. Formaldehyde is adsorbed to a less extent than carbon bisulphide but at about the same rate as chloropicrin. Adsorption probably impairs the efficiency of volatile fumigants by reducing the concentration and the diffusion of vapour in the soil, especially in the case of chloropicrin. Because some soil fumigants are more readily adsorbed than others, the efficiency of one may be impaired more than another when a heavy soil is treated, which may account for the differences obtained in investigations on the relative effectiveness of various soil fumigants.

BLACK (L. M.). **Different Vector Specificities for Varieties of a Plant Virus.** (Abstract.)—*Phytopathology* **33** no. 1 p. 17. Lancaster, Pa., 1943.

Additional experiments confirmed those previously recorded [*R.A.E.*, A **31** 4] as to the specificity of the transmission of the New York strain of the virus of yellow-dwarf of potato (*Marmor vastans* of Holmes, var. *vulgare*) by *Acerata-gallia sanguinolenta*, Prov., and of the New Jersey strain (*M. v. agalliae* of Black) by *Agallia constricta*, Van D.

MOOK (P. V.) & WOLFENBARGER (D. O.). **Distribution of *Beauveria bassiana* on Elm Insects in the United States.**—*Phytopathology* **33** no. 1 pp. 76–77, 1 ref. Lancaster, Pa., 1943.

The results are given of investigations in the United States during 1941–42 to determine the distribution of *Beauveria bassiana* and its insect hosts on elm. The fungus was cultured from adults of *Scolytus multistriatus*, Marsh., in New Jersey, Pennsylvania and Virginia, *Hylastes* (*Hylurgopinus*) *rufipes*, Eich., in Massachusetts, New Hampshire and New Jersey, *Magdalis barbita*, Say, *M. armicollis*, Say, and *Tremex columba*, L., in New Jersey, and *Eutetrapha* (*Saperda*) *tridentata*, Ol., in New York. *Ceratostomella ulmi*, the fungus that causes Dutch elm disease, has been isolated from all these insects, except *T. columba*.

PLUMMER (C. C.). **Studies on the Toxicity of Tartar Emetic to the Mexican Fruit Fly (*Anastrepha ludens* Loew) and the Effects of Applications of Tartar Emetic on Citrus Trees.**—*Abstr. doct. Diss. Ohio Univ.* no. 35 pp. 117–122, 1 graph. Columbus, Ohio, 1941. [Recd. 1943.]

The adults of *Anastrepha ludens*, Lw., used in these experiments, the technique of which is described, were fed for 1–2 weeks on pieces of orange, cube sugar and water at room temperature and were then transferred with food to cages kept at 25°C. [77°F.] and about 30 per cent. relative humidity. After 24 hours, a glass plate on which a solution of tartar emetic and sugar had dried was substituted for the sugar and orange. It was found that the average

length of life was significantly greater when the toxicity tests were begun early in the morning than when they were begun in the evening, and that it tended to vary directly with the size of the cage. In tests in which the flies were fed for 3, 6 or 12 hours following starvation for 24 hours and then exposed to the poison, the average length of life increased with the period of feeding. Experiments to determine the toxicity of the residues from sprays containing from 2 oz. to 8 lb. tartar emetic and 20 lb. sugar per 100 U.S. gals. showed that, except in one series, which is considered invalid, there was little difference in mean length of life of flies exposed to concentrations of 2–8 lb. and only a slight increase at 1 lb. Below this, however, there were considerable increases. There was no evidence that the sexes differed in susceptibility.

Workers in the Panama Canal Zone and Florida have found that sprays containing tartar emetic cause no damage to the foliage of *Citrus* unless they are applied very heavily and repeatedly, and examination of sprayed oranges and grapefruit from Mexico showed that repeated applications of bait-sprays containing it did not affect the quality of the fruit.

MARKOS (B. G.). **Effect of Host Plant on the Susceptibility of the Southern Armyworm, *Prodenia eridania* Cram., to Calcium Arsenate.**—*Abstr. doct. Diss. Ohio Univ.* no. 35 pp. 193–200, 2 refs. Columbus, Ohio, 1941. [Recd. 1943.]

The following is based on the author's summary of experiments in which strips of the leaves of eight plants were dusted with calcium arsenate by a standard method, cut into small pieces calculated to bear the required dose, and offered to hungry sixth-instar larvae of *Laphygma* (*Prodenia*) *eridania*, Cram., reared on the respective plants. The median lethal dose of calcium arsenate on a variety of bean regarded as the standard was 0·18 mg. per gm. body weight. The larvae showed varying degrees of susceptibility when this dose was ingested on leaves of the other plants; they were much more susceptible on rhubarb, and much more resistant on maize, soy bean, squash and burdock [*Arctium lappa*] than on bean, somewhat more resistant on hollyhock [*Althaea*] and not significantly so on kale. There was no relation between their susceptibility and the fresh and dry weight or moisture content of the foliage, nor did the amount of bean leaf ingested with the poison affect its toxicity. The hydrogen-ion concentration of the juices of the ingested leaf did not affect that of the intestinal contents. The amount of arsenic in calcium arsenate rendered soluble *in vitro* by the juices of the foliage of the different species of plants was not directly correlated with the susceptibility of the insect when the arsenical was offered on these plants. The amount of arsenic recovered at the end of 15 and 30 minutes from the foregut and midgut of the larva may be correlated with the amount of arsenic rendered soluble in the juice of the foliage of the food-plant. Oxalic acid increased the toxicity of the arsenate on bean, which explained the susceptibility of the larvae to calcium arsenate on rhubarb, which contains oxalic acid.

WALKDEN (H. H.) & WHELAN (D. B.). **Owlet Moths (Phalaenidae) taken at Light Traps in Kansas and Nebraska.**—*Circ. U.S. Dep. Agric.* no. 643, 25 pp., 11 figs., 1 ref. Washington, D.C., 1942.

This circular contains data on the distribution, seasonal flight records and peaks of abundance of Noctuid moths in the Missouri Basin, obtained by means of light-traps operated at six widely separated points in Kansas and Nebraska from March to November in 1934–37. The traps and the positions in which they were installed are described, and the 305 species taken are recorded in a table with localities, numbers captured and flight periods, and, for those of which 25 or more individuals were collected, the proportion of the sexes. Graphs are

given showing the seasonal flight records of the whole group and of certain species of economic importance. These comprise *Chorizagrotis auxiliaris*, Grote, *Feltia subgothica*, Haw., *Agrotis venerabilis*, Wlk., *A. gladiaria*, Morr., *A. orthogonia*, Morr., and *Euxoa niveilinea*, Grote, which have one generation a year, and *Hadena* (*Scotogramma*) *trifolii*, Rott., *Caenurgina erechtea*, Cram., *C. crassiuscula*, Haw., *Cirphis* (*Leucania*) *unipuncta*, Haw., *Heliothis armigera*, Hb., and *Prodenia ornithogalli*, Gn., which have more than one. About 90 per cent. of the 525,000 moths collected belonged to species of economic importance.

BLANCHARD (R. A.). **Hibernation of the Corn Earworm in the central and north-eastern Parts of the United States.**—*Tech. Bull. U.S. Dep. Agric.* no. 838, 13 pp., 1 fig., 9 refs. Washington, D.C., 1942.

The following is based on the author's summary. Cage experiments supplemented by field studies extending over the central and north-eastern United States have been in progress since 1935 in an attempt to determine the northern limits of successful hibernation of *Heliothis armigera*, Hb., and to learn more about the factors involved [*cf. R.A.E.*, A **28** 347; **29** 419, 481]. Cages into which larvae were introduced were established in exposed soils of several kinds, in lucerne and grass sod, under shocks of maize and under an open shed. Field studies included soil examination in exposed soil in maize, lucerne and soy-bean fields, under and round maize shocks and under cannery buildings, where large numbers of larvae entered hibernation. A wide range of soil types was included.

In cages established late in August, 21–100 per cent. of the estimated total possible adult emergence occurred in autumn. Apparently the period from the middle of September to early October is the optimum time for larvae to enter the soil, pupate and hibernate successfully. Those that mature after the middle of October are unable to enter hibernation in the central and northern States. Moth emergence in cages extended, for the whole area, from the second week in May to the last week in June, and occurred at approximately the same times in the field. Lethal low temperatures were not reached at any of the localities; length of exposure would seem to explain the lack of survival at many of the points of observation. Biotic factors that were found to cause mortality among the hibernating population were fungous and bacterial diseases, earthworms, ants, Nematodes, Carabid larvae, moles, rodents and roots of growing plants [*cf.* **30** 267]. They appeared to be more important in areas with a mild winter climate than where temperatures were lower. Factors observed to affect hibernation indirectly under field conditions were the time of planting and rate of maturing of the maize and the time of the first frost in autumn. Late maize, which provided food for the largest numbers of larvae of the overwintering generation, was planted largely in heavier, poorly drained soils and thereby offered the poorest chances for survival of the pupae because of excess moisture. Dry weather in autumn and rapid maturing of the maize, sometimes hastened by frost, resulted in considerable autumn mortality of larvae that would otherwise have hibernated; large numbers of late-maturing larvae were destroyed directly by frost, or, if they entered the soil, failed to pupate because of low temperatures.

In central Illinois, an occasional living pupa was found in protected soil round a cannery building during the spring of 1937, and occasional living pupae were found in maize fields after the mild winters of 1936–37 and 1937–38. In every case, the pupae were in sandy soil or in well-drained soil with unrotted plant débris below them, which made the drainage better than usual. In southern Illinois, no survival was observed under field conditions, probably because the soils in which most hibernation took place were wet clay types. Larvae feeding on ears of maize in shocks and those that could have entered the soil under cannery buildings tended to leave the cover before doing so.

Cultural operations to destroy hibernating individuals are recommended only for abandoned maize fields. Circumstantial evidence points to migrations from the south as the source of infestations in the northern parts of the United States.

PATCH (L. H.). **Survival, Weight, and Location of European Corn Borers feeding on resistant and susceptible Field Corn.**—*J. agric. Res.* **66** no. 1 pp. 7–19, 3 figs., 4 refs. Washington, D.C., 1943.

The following is based on the author's summary. Tests in Ohio between 1932 and 1939, inclusive, with two maize hybrids of which one was highly resistant and the other highly susceptible to infestation by *Pyrausta nubilalis*, Hb., showed that survival of the larvae is materially greater on the latter, and this was at first attributed to the greater availability of the tassel buds for larval feeding, since in the resistant hybrid the upper leaves are wrapped round the tassel almost until the pollen is ripe. Experiments to test this hypothesis and to determine the extent to which survival is influenced by the stage of plant development and the presence of tassels at the time of hatching were made in 1936 and 1937.

Most of the differentiation in survival occurred within the first few days of hatching and thereafter it was relatively the same in both hybrids. The larvae developed more slowly in the resistant one, and further indications of its unsuitability as food were given by feeding characteristics, such as the shape and size of the feeding scars and the texture and colour of the excrement, and the relative weights of larvae fed on the two hybrids. Although the greater availability of the tassel buds in the susceptible hybrid appears to contribute to the more rapid growth of the larvae, the general unsuitability of the resistant hybrid as food is evidently a major factor in survival and probably in decreasing the rate of growth. Differences in survival on the two hybrids became less as the plants were nearer the pollen-shedding stage when the larvae hatched, both on normal plants and on others from which the tassels were removed.

On plants that shed their pollen 14–20 days after the larvae hatched, the percentage of larvae less than 13 days old that occurred in the tassels was much greater on the susceptible hybrid, and the percentage present in the whorls, ligules and mid-ribs was almost equally greater on the resistant one. Most of the differentiation in survival occurred among larvae in the leaf-whorls. When the larvae were 17–55 days old, a larger proportion occurred in the ears and internodes on the susceptible than on the resistant hybrid, and when they were about half-grown, the proportion in internodes 9–12, at the upper part of the stem, was nearly equal in both hybrids and that in the four nearest the ground was smaller in the resistant one. As they became older, the larvae left the upper internodes to enter those lower down, but they did so to a less extent in the resistant hybrid.

POOS (F. W.). **The Potato Leafhopper, a Pest of Alfalfa in the eastern States.**—*Leafl. U.S. Dep. Agric.* no. 229, 8 pp., 3 figs. Washington, D.C., 1942.

Empoasca fabae, Harr., which occurs throughout the United States, with the possible exception of the north-west, is one of the most important pests of lucerne in the eastern half of the country. Brief accounts are given of the damage it causes [*cf. R.A.E.*, A **24** 527; **25** 37; **26** 216], its bionomics [*cf.* **31** 56] and measures for its control. The life-cycle lasts about three weeks under favourable conditions; the generations overlap in the field and cannot be definitely distinguished, but six were produced between May and October in an outdoor insectary in Virginia. Much injury occurs in young stands of lucerne, where it permits weeds and grasses to crowd out the crop or may weaken it so severely that it does not survive the following winter.

Both nymphs and adults are destroyed by spiders, mites, predacious insects and the fungus, *Entomophthora sphaerosperma*, but none of these gives satisfactory

control. Lucerne should be grown as far as possible from large plantings of beans, potatoes or other favoured food-plants. A 30-foot strip of a cereal between lucerne and preferred food-plants prevents noticeable injury by migrating nymphs. Delaying the cutting of the first crop for 10–14 days is often effective in keeping populations low [*cf.* **22** 598, etc.], but if it is delayed until much new growth appears at the crowns of the plants, the young nymphs will be able to develop and the next crop will be heavily infested. In plot tests, a dust containing 0·0825 per cent. pyrethrins, 0·6875 per cent. petroleum hydrocarbons, 66 per cent. sulphur, of which 98–100 per cent. would pass through a 325-mesh screen, and 33·23 per cent. inert ingredients, applied once at the rate of about 25 lb. per acre, killed approximately 98 per cent. of the leafhoppers under field conditions, and such treatment has been shown to increase the yield by as much as 28 per cent.

Balduf (W. V.) & Slater (J. S.). **Additions to the Bionomics of** *Sinea diadema* **(Fabr.). (Reduviidae, Hemiptera.)**—*Proc. ent. Soc. Wash.* **45** no. 1 pp. 11–18, 18 refs. Washington, D.C., 1943.

The authors give additional data, obtained chiefly at Urbana, Illinois, on the bionomics of *Sinea diadema*, F. [*cf. R.A.E.*, A **12** 173], which is the commonest Reduviid in that State. It is shown that the winter is passed in the egg stage in the Urbana area, and details are given of the seasonal development of the two generations that occur in the year, the relation of the quantity of food (adults of *Drosophila melanogaster*, Mg.) to growth, and the way in which the bugs caught and fed on a beetle and a Capsid. Some 20 species of insects on which they were observed to prey in the field and additional records from the literature are shown in tables.

Harris (K. L.). **Some Applications of Insect Separation Methods to Entomology.**—*Proc. ent. Soc. Wash.* **45** no. 1 pp. 19–25, 1 fig., 43 refs. Washington, D.C., 1943.

The author reviews methods that have been used for several years by the United States Food and Drug Administration to remove insects from samples of foods and drugs, and gives details of some of them. In addition to mechanical screening, various processes are employed, and these are usually based on solubility of the food or drug and insolubility of the insects, preferential wetting of insects or insect fragments by oily liquids, which allows their separation by flotation, or selective sedimentation in water or liquids heavier than water.

List of Intercepted Plant Pests, 1941.—*S.R.A., B.E.P.Q.* [1941] 50 pp. [Washington, D.C.] U.S. Dep. Agric., 1942.

This list of pests intercepted between 1st July 1940 and 30th June 1941 with plants or plant products entering United States territory (including Hawaii and Porto Rico) resembles the previous one [*R.A.E.*, A **30** 556] in the selection and arrangement of the data, but includes a list of fungi attacking some of the insects.

Rusk (H. W.). **Rapid Method for Determination of small Quantities of Copper on Apples when Lead Arsenate is also present.**—*J. Ass. off. agric. Chem.* **25** no. 4 pp. 980–987, 1 graph, 11 refs. Washington, D.C., 1942.

The following is substantially the author's summary. A rapid method for the isolation and determination of small quantities of copper from fruit that also bears lead arsenate residues is described. The samples may be prepared either by acid digestion of the peels or by stripping the whole apple with a solution containing nitric acid and ammonium nitrate. The latter is preferable when it is desired to determine the lead and arsenic. In either case, the copper

is isolated with diphenylthiocarbazone, the complex formed with it destroyed with nitric acid and potassium chlorate, and the copper finally estimated colorimetrically in the form of carbamate by means of a photoelectric photometer. The procedure is simple, rapid and well suited to the routine analysis of the large number of samples encountered in work on spray residues. Recovery is shown to be practically complete, and a standard deviation of less than 2 per cent. among replicate analyses may be expected.

MATHLEIN (R.). **Undersökningar rörande förrådskadedjur. II. Kornmalarna,** *Tinea secalella* **Zacher och** *Tinea granella* **L.** [Investigations on Pests of stored Products. II. The Grain Moths, *T. secalella* and *T. granella*.]—*Medd. Växtskyddsanst.* no. 34, 56 pp., 10 figs., 21 refs. Stockholm, 1941. (With a Summary in German.) [Recd. 1943.]

Infestation of stored grain by grain moths has increased in Sweden of recent years in spite of improved methods of storage and control, and investigations in southern and central districts in 1939 showed that the species responsible was *Tinea secalella*, Zacher [*cf. R.A.E.*, A **27** 220]. *T. granella*, L., was not found. Differences in the male genitalia of these two species are described and figured, and all stages of *T. secalella* are described. The authors state that F. Zacher has informed them that *T. secalella* is commoner than *T. granella* in stored grain in Germany and Poland, is the dominant species in Finland and is apparently absent from Italy.

The moths emerge over a period of 2–3 weeks in mid-summer, but are seldom observed, as they are active only at night. Pairing occurs a few hours after emergence, and oviposition begins within 2 days. One male can fertilise at least two females. In an experiment in which 74 newly emerged pairs were isolated, the oviposition period lasted 3–13 days, and the number of eggs laid per female ranged from 29 to 218 and averaged 108. Generally not more than 2 eggs are laid on a single grain, but they are also deposited on sacks, dust and débris. The adults do not live for more than about a fortnight. The duration of the egg stage varied from 5 days at 27°C. [80·6°F.] to 40–45 at 11–12°C. [51·8–53·6°F.]. The larvae enter the grains and feed principally on the germ. Their presence is difficult to recognise until the appearance of excrement on the outside of the grains, but as they migrate from grain to grain and spin them together with threads, clumps of grain and excrement are formed and the mass acquires an unpleasant odour. Little damage was done in grain of which the moisture content was 14 per cent. or less.

There is usually one generation and a partial second in the year, and the winter is passed in the larval stage. The overwintered larvae leave the grain in spring and pupate in cocoons in cracks in walls, floors or wooden objects, and the adults emerge 2–3 weeks later. Exposure to winter cold seems essential for survival, since cultures that were kept at room temperature throughout the winter died out. In summer, pupation occurs mostly in the grain, and the adults emerge in July–August. In tests on the effect of temperature and relative humidity on development, in which the food was rye, the egg, larval and pupal stages lasted 6, 45–58 and 8 days at 27°C. and 90 per cent., 6, 64–92 and 8 days at 27°C. and 65 per cent., 7, 30–52 and 10 days at 24–25°C. [75·2–77°F.] and 90 per cent., 12, 50–73 and 15 days at 17–21°C. [62·6–69·8°F.] and 90 per cent., and 14, 86 and 25 days at 15–17°C. [59–62·6°F.] and 65 per cent., respectively. The optimum for development lies at about 25°C., and high humidity is favourable. Newly hatched larvae kept at 6–8°C. [42·8–46·4°F.] from mid-June did not increase in size but resumed development normally when transferred to a higher temperature 13 months later; and some of a batch of full-fed larvae kept at −6°C. [21·2°F.] were still alive after 160 days.

The grains attacked, in order of decreasing preference, are rye, wheat, barley and oats, but the larvae also develop in maize, bran and seeds of grass, clover or

flax. The parasites, *Nemeritis canescens*, Grav., and *Chremylus rubiginosus*, Nees, are common in infested grain stores and sometimes give considerable control. In laboratory experiments, the larvae were attacked by *Metarrhizium* sp., which gave complete mortality at a relative humidity as low as 50–60 per cent. When the conidia of this fungus were mixed with infested rye, all the larvae died in 3–4 weeks.

Infestation is favoured by the old wooden buildings in which grain is stored in many parts of Sweden, and it is suggested that these should be lined with some smooth material to reduce the number of overwintering sites and provided with ventilation. Grain is not protected from infestation by ordinary jute sacks, but a lining of kraftpaper was effective, though it did not prevent the emergence of larvae already in the grain. Other methods of reducing infestation are storage at temperatures not higher than 6°C. and drying the grain to a moisture content of not more than 14–16 per cent. When rye was artificially infested with eggs and stored in air-tight bottles for 7 weeks it suffered very little damage, and all the larvae were found to have died. Air-tight storage, however, requires specially constructed silos and a temperature of not over 15°C. Silos in which the grain is subjected to air currents, which prevent pairing and oviposition by the moths and dry the grain, so that it provides unfavourable conditions for the larvae, have given good results. Granaries can be freed from infestation by clearing them of all débris and keeping them empty through the spring and summer. No control was given by turning the grain, covering it with damp cloth to attract the larvae or placing dishes of water on the floor to trap the moths, and though numbers of moths were caught on papers or boards covered with adhesive, many of these had already oviposited and the subsequent reduction in infestation was slight. All stages were killed by keeping the grain at a temperature of 48–50°C. [118·4–122°F.] for one hour, or 44°C. [111·2°F.] if a vacuum apparatus was used. Of the various insecticides tested, a pyrethrum powder of high quality (Pyretin) was by far the best. It was effective against adults and larvae brought into contact with very small quantities and gave excellent control when mixed with infested grain. Derris powder was inferior. Sprays of pyrethrum extract in oil or water were also effective against the adults, but proved too expensive to use against the overwintering larvae, since large quantities are required to reach all the hibernation sites. Gas-tight granaries can be fumigated with hydrocyanic acid gas at a concentration of 1–1·5 volumes per cent. and small lots of grain or empty sacks can be fumigated with Areginal. Nicotine fumigation is effective against the adults, but has no effect on the other stages.

Lindblom (A.). **Skadedjur i Sverige år 1937.** [Pests in Sweden in 1937.]—*Medd. Växtskyddsanst.* no. 35, 54 pp., 19 figs. Stockholm, 1941. [Recd. 1943.]

Lists are given of agricultural and horticultural pests reported by observers in various parts of Sweden in 1937. The number of species reported was increased to 340 [*cf. R.A.E.*, A **27** 355], and of these 301 were insects and 19 mites. No serious outbreaks are recorded.

Ahlberg (O.). **Krysantemumgallmyggan,** *Diarthronomyia chrysanthemi* **Ahlb., och dess bekämpning.** [The Chrysanthemum Gall-midge, *D. chrysanthemi*, and its Control.]—*Medd. Växtskyddsanst.* no. 38, 32 pp., 12 figs., 36 refs. Stockholm, 1942. (With a Summary in German.)

Descriptions are given of all stages of *Diarthronomyia chrysanthemi*, Ahlberg, the Cecidomyiid that was previously misidentified as *Misospatha* (*D.*) *hypogaea*, F. Lw. [*cf. R.A.E.*, A **28** 111], together with an account of its spread on chrysanthemums to Europe and present distribution there [*cf.* **27** 673]. One infestation in southern Finland was traced to cuttings imported from Lübeck in 1934,

so that it is concluded that the Cecidomyiid was already present in Germany in 1933. It was also found on cuttings sent from Germany to Sweden in 1937. It was first recorded in Sweden in 1936 and has since been found in greenhouses in several localities there. Its life-history is briefly described, partly from the literature [**8** 364] ; the eggs usually hatch in about 5 days, and the galls first become noticeable about a week after the larvae have entered the plant. Only young tender growth is attacked. It probably has about six generations a year on chrysanthemums cultivated under glass throughout the summer, and it appears unlikely that it can survive the winter in the open in northern Europe. Larvae and pupae in their galls survived temperatures of about 3°C. [37·4°F.] for 4–5 months, but all those exposed to natural temperatures of about 0·5°C. [32·9°F.], with a minimum of −5°C. [23°F.], died.

The original food-plant of *D. chrysanthemi* is unknown, but in the greenhouse it appears to attack exclusively *Chrysanthemum indicum* and its varieties ; in experiments, *C. frutescens* was not attacked. The damage caused to the plants varies with the part attacked. Galls on the leaves do not affect growth or the appearance of the plants unless they are very numerous. The flowers are spoiled if galls occur in the capitula, and the plants are stunted if they are formed on the shoots of young plants. Infestation sometimes causes the stems to break.

In experiments, complete control of the eggs was given by a spray containing 0·1 per cent. nicotine and 0·5–0·75 per cent. soap, which should be applied every 4 days during the oviposition period. Fumigation with hydrocyanic acid gas (derived from Cyanogas calcium cyanide) at a concentration 0·004 volume per cent. was effective against the adults, but has to be applied every night for 5–6 weeks, while the adults are emerging [*cf.* **8** 365]. During winter, the soil in glasshouses should be sterilised by steam, or changed for fresh soil, and all plant parts removed. The houses can also be disinfested by maintaining their temperature after the plants are removed, which hastens emergence, and using them for other plants. Care should be taken that all fresh cuttings are free from infestation, and they should be planted in uninfested soil ; as a precaution, they should be immersed in a dip containing 0·1–0·2 per cent. nicotine.

BEIRNE (B. P.). *Argyresthia conjugella,* **Zell., and other Lepidopterous Pests in Ireland during 1942.**—*Econ. Proc. R. Dublin Soc.* **3** no. 13 pp. 163–171, 3 figs., 12 refs. Dublin, 1943.

Further collections of Lepidopterous larvae, made in three counties in Eire in 1942, included six additional species on apple [*cf. R.A.E.*, A **30** 406]. The only one that was injurious was *Argyresthia conjugella,* Zell., which infests the fruits and is widely distributed in Ireland, but had not previously been recorded as a pest there. An account is given of its distribution, bionomics and control, based chiefly on the literature [*cf.* **26** 299, etc.]. It had caused serious injury to apples in an orchard in County Limerick for several years and had been observed there 10 and 20 years previously. Both apples and the fruits of mountain ash, *Sorbus* (*Pyrus*) *aucuparia,* from the woods nearby were heavily infested in 1942. The average number of larvae per apple was 2 or 3, but many apples were free from attack. Infestation had been more severe in 1941. The winter was passed in the pupal stage, usually on or in the ground or among dead leaves or rubbish, and the adults emerged in June or July. No parasites were bred from the larvae.

WILSON (G. F.). **A Flea Beetle Trap.**—*J. R. hort. Soc.* **68** pt. 4 pp. 106–107, 1 pl., 1 fig., 1 ref. London, 1943.

The author describes modifications of a mobile trap for catching flea-beetles [*Phyllotreta* spp.] on cruciferous crops [*R.A.E.*, A **3** 96]. It is pushed along the

drills, not pulled as previously recommended, and is improved by arranging the inner borders of the sloping boards as near the ground as possible and by erecting a cardboard hood over the boards so that beetles that jump high hit the cover and are thrown back on to the sticky boards.

Mosley (F. O.). **Onion Fly Control in the Field.**—*Agriculture* **49** no. 4 pp. 222–224, 1 pl., 3 refs. London, 1943.

Practical experience of the use of calomel [mercurous chloride] for the control of the onion fly [*Hylemyia antiqua*, Mg.] in Britain [*R.A.E.*, A **26** 298 ; **27** 674] has shown that if it is to be mixed with large amounts of seed, a mechanical mixer is required. An apparatus similar to that used for the dry dressing of seed grain is satisfactory and is described. The seed is first mixed with the adhesive and then with the calomel. It has been found that the maximum amount of calomel that will adhere to the seed when large quantities are involved appears to be 12 oz. per lb. of seed, but in view of the reduced control obtained with this amount in experiments [**27** 674], the use of equal weights of seed and dust is advised ; special care is then necessary to prevent the loose dust from accumulating in the hopper of the smaller types of hand-drill, thus choking it and causing irregular delivery of the seed.

If the calomel is applied as a 4 per cent. dust along the rows, a rotary dust distributor with flat nozzles capable of applying it as a band extending for 1½ ins. on each side of the crop row is recommended. If the date for the second application of dust [**27** 674] coincides with that for a second application of sulphuric acid against weeds, the spray should be applied first and an interval of at least one day allowed to elapse before applying the dust.

Keilin (D.) & Tate (P.). **The larval Stages of the Celery Fly** (*Acidia heraclei* **L.) and of the Braconid** *Adelura apii* **(Curtis), with Notes upon an associated parasitic Yeast-like Fungus.**—*Parasitology* **35** no. 1–2 pp. 27–36, 18 figs., 12 refs. London, 1943.

The following is taken partly from the authors' summary. Descriptions are given of the three larval instars of *Acidia heraclei*, L., which sometimes causes serious damage to celery and occasionally also to parsnip in England, and of the first-instar larva of its Braconid parasite, *Adelura apii*, Curt. A yeast-like fungus occurs as a parasite in the blood of *Acidia* larvae, but is found only in those that are parasitised by larvae of *Adelura* or bear evidence, in the form of phagocytic cysts round dead larvae or eggs or healed puncture marks on the body wall, of having been attacked by this Braconid. Dense mycelial masses sometimes occur in the gut of *Adelura* pupae and are probably derived from the yeast cells parasitic in the host larvae. It is suggested that this is a unique case of a fungus parasitic in a host larva (*Acidia*) undergoing part of its development in a parasitic Braconid (*Adelura*), adult females of which transmit the fungus to the host larvae during oviposition.

Gobeil (A. R.). **Forest Entomology. Fourth annual Report for the Year ending March the 31st, 1941.**—*Rep. Dep. Lds For. Quebec 1940–41* repr. 16 pp., 3 figs. ; also as *Contrib. For. Prot. Serv. Quebec* no. 14, 16 pp. Quebec, 1942.

This report on entomological work carried out in the forests of Quebec in the year ending 31st March 1941 contains brief accounts of the forest insect survey, by R. Lambert (pp. 6–8), the main results of which have already been

noticed [*cf. R.A.E.*, A **29** 431], and of the permanent sample plots and inspections, by M. E. Genest (pp. 8–9), and sections dealing with the bionomics of the spruce sawfly, *Gilpinia hercyniae*, Htg. (*Diprion polytomum*, auct.), including a note (p. 10) by A. R. Gobeil on factors affecting diapause in this and other sawflies [*cf.* **30** 452]. G. Paquet (pp. 10–13) gives and discusses a chart showing the differences in dates of cocoon formation by *G. hercyniae* in various parts of the Province, the figures being based on the stages of development of the larvae in samples from them and the dates of cocoon formation in the laboratory, and also summarises work in 1940 on the liberation of parasites, of which *Microplectron fuscipenne*, Zett., is the most important. R. Martineau (pp. 13–15) discusses sylvicultural and natural control [*cf.* **30** 285 ; **31** 213]. Comparative analysis of forest and entomological data gathered in the field indicates that the humus layer covering the mineral soil influences emergence through the amount of water that it retains, which varies with its depth ; in a dry place, deep humus is beneficial to the insect, which requires humidity for its development, but in very moist conditions a deep humus layer tends to lower the temperature and thus delays development. The percentage emergence for a given area is inversely proportional to the percentage of the area shaded by the tree crowns, and generally increases with the distance from the tree trunk. The feeding larvae, and probably the ovipositing females, are positively phototropic, since the larvae are least numerous on the north side of a tree, and infestation is generally greater in open forest stands.

Webster (J. E.) & Wall (R.). **Electrical Conductivities of Sorghum Juices in Relation to Chinch Bug Injury.**—*Proc. Okla. Acad. Sci.* **22** pp. 35–37, 3 refs. Edmond, Okla., 1942.

The following is the authors' summary of the investigations described, which were carried out in Oklahoma in 1937–41. There is little if any significant change in specific conductivities of the juices from various sorghum varieties after the earlier stages of growth. Such differences as are shown fail to correlate with the observed differences in resistance to injury by the chinch bug [*Blissus leucopterus*, Say]. Similarity of varietal results also indicates that specific conductivity is probably not a factor in explaining varietal differences in chinch-bug resistance.

Fenton (F. A.). **The Insect Pest Record for Oklahoma, 1941.**—*Proc. Okla. Acad. Sci.* **22** pp. 45–51. Edmond, Okla., 1942.

Crop losses due to infestation by insects were unusually severe in Oklahoma in 1941. Records are given of the pests observed, together with brief notes on the more injurious. These included *Conotrachelus nenuphar*, Hbst., on peach and plum, *Longistigma caryae*, Harr., on pecan, *Paleacrita vernata*, Peck, on orchard and shade trees, *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) on lucerne, in one field of which it was checked by *Entomophthora* (*Empusa*) *aphidis*, *Anthonomus grandis*, Boh., on cotton, *Diatraea grandiosella*, Dyar, on maize, *Agrotis orthogonia*, Morr., and *Cirphis unipuncta*, Haw., on wheat, *Celama sorghiella*, Ril., and *Solubea pugnax*, F., on sorghum, and *Chorizagrotis auxiliaris*, Grote, on wheat, oats, barley and rye. The area of crops destroyed by the over-wintered adults and first-generation of *Blissus leucopterus*, Say, increased from 86,113 acres in 1940 [*cf. R.A.E.*, A **30** 59] to 125,520 in 1941, and infestation by the grasshoppers, *Aeoloplus turnbulli*, Thos., and *Melanoplus mexicanus*, Sauss., was severe. *A. turnbulli* was somewhat reduced by fungous disease in June, but *M. mexicanus* developed a second generation that necessitated late applications of bait. *M. differentialis*, Thos., and *M. bivittatus*, Say, were also present. *Laemophloeus minutus*, Ol., was by far the most numerous pest of stored wheat.

Smith (G. L.). **California Cotton Insects.**—*Bull. Calif. agric. Exp. Sta.* no. 660, 50 pp., 35 figs., 13 refs. Berkeley, Calif., 1942.

The cultivation of cotton in California has increased rapidly of recent years, but in some districts insect pests have caused serious losses. Since comparatively little is known of cotton insects in this region, investigations on them were begun in 1935, and notes on their habits and control are given in this bulletin.

The most important in the San Joaquin Valley is *Lygus hesperus*, Knight, which migrates to cotton from lucerne, weeds and other plants. Feeding by the nymphs and adults causes increased drop of buds, flowers and small bolls, a late crop, much of which is not mature when frost and rains occur, destruction of the seeds or reduction of their oil content or germinating power, and the production of abnormal bolls, weak and discoloured lint or deformed plants. Methods of ascertaining the presence of this Capsid in injurious numbers are described, and it is suggested that, to decrease damage, lucerne should be cut as often and as early as possible and weeds should be destroyed during April and May and in November. Of nine dusts tested, sulphur and Paris green (12 : 1) and sulphur and calcium arsenate (2 : 1) gave the greatest increase in yield and the most satisfactory control of nymphs. Insecticides should not be applied between about sunrise and mid-afternoon, or the crop from that day's flowers will be lost. *Chlamydatus associatus*, Uhl., was much the most numerous of the other Capsids on cotton in the San Joaquin Valley, where burweeds (*Franseria* spp.) are its preferred food-plants. The eggs are laid in the stems ; those that had overwintered in the dry burweed stems hatched during 1st–20th April, but no nymphs were obtained from dry stems of cotton. Reproduction on cotton in cages continued throughout the season, and the adults occur on the crop from the beginning of May until September, and are most numerous in flowers during July and August. Both nymphs and adults feed on the more succulent leaves, buds, flowers and stems, causing premature opening of bolls, weak fibre, and numerous undeveloped seeds. To prevent infestation, burweeds should be burnt during autumn and winter to destroy the eggs, and the spring growth near cotton fields should be destroyed. Capsids of potential importance are *Psallus seriatus*, Reut., which is more numerous on its wild food-plants than on cotton, and *Creontiades femoralis*, Van D., which may cause deformation and reduction in yield and also infests lucerne.

The Pentatomid, *Chlorochroa sayi*, Stål, is destructive every year in Imperial and Riverside counties but rarely becomes injurious throughout the San Joaquin Valley. Overwintering adults live about eight months, and those that develop in spring and summer two or three. The female lays an average of 150 eggs, in several clusters, and the egg stage varies from 5 days in July to 15 in spring. *Telenomus mesillae*, Ckll., parasitises an average of 48 per cent. of the eggs, and Tachinids about 3–5 per cent. of the adults. The bugs feed principally on seeds, and prefer plants other than cotton, which is rarely injured before mid-July, when small grains are harvested. Small numbers may do considerable damage, however, since they feed on many bolls in various stages of growth, causing shrivelled seeds and unpickable fibre and sometimes disseminate fungi that cause boll rot. Preferred food-plants should not be destroyed when the bolls are developing (in late June–October), but in early winter and spring and immediately after harvest in grain fields. The use of chemicals for control is difficult, but dusts of dinitro-o-cyclohexylphenol mixed with sulphur have shown promise ; they should not be used after mid-August until more is known of their staining effect on cotton. Two other Pentatomids, *Thyanta custator*, F., which is usually scarce in California, and *Euschistus impictiventris*, Stål, which is of importance there only in Riverside and Imperial counties, cause similar but more severe injury, and the Pyrrhocorid, *Euryophthalmus convivus*, Stål, which is rare, occasionally causes serious damage to the bolls. *Nysius minutus*, Uhl., sometimes kills or seriously injures seedling cotton. It breeds

chiefly in grassland, and burning grass and weeds along the edges of the fields, and frequent cultivation, irrigation or flooding kill many of the nymphs. Sprays of 1 U.S. pint nicotine sulphate and 4–5 lb. fish-oil soap in 100 U.S. gals. water or a dust of 25 per cent. calcium cyanide are also recommended.

Aphis gossypii, Glov., is injurious in some localities, and *A. medicaginis*, Koch, is a serious pest of the young seedlings, which it sometimes destroys, but is seldom found on older cotton. *Trialeurodes pergandei*, Quaint., is the only Aleurodid of much importance in cotton fields. It develops on *Euphorbia ocellata*, which should be destroyed before July.

Hercothrips fasciatus, Perg. [*cf. R.A.E.*, A **21** 590; **26** 128] feeds on the leaves and sometimes on soft stems. The injured leaves drop, and later, squares, flowers and small bolls are shed, and bolls may open prematurely. With good coverage, dusts containing dinitro-o-cyclohexylphenol have given very good control. Another thrips, *Frankliniella occidentalis*, Perg., occurs on cotton throughout the season and stunts the plants.

Several species of Lepidoptera are injurious, and dusts or sprays of arsenicals or fluosilicates are recommended against most of them. The eggs of *Strymon melinus*, Hb., are laid singly on the succulent growth, and larvae of this Lycaenid occur on the plants from May to November. They destroy flower buds, small bolls and occasionally succulent stems, and facilitate the introduction of boll rots. Overwintering pupae on dead plants can be killed by burning or ploughing under stalks and weeds between December and February. The larvae of *Prodenia praefica*, Grote, usually migrate from lucerne to cotton, on which they destroy the leaves, cut off stems and enter bolls. Control recommendations include thorough cultivation to kill the overwintering pupae, trapping the migrating larvae by means of ditches, and the use of poison baits. *Heliothis armigera*, Hb., feeds on the bolls, and *Peridroma saucia*, Hb. (*Lycophotia margaritosa*, Haw.) and other cutworms occur in cottonseed trash and late bolls, feed on foliage and kill seedlings; they should be controlled by ploughing and working the fields and cleaning weedy areas in spring, and the cutworms by poison baits. *Plusia* (*Autographa*) *californica*, Speyer, does not cause serious damage, but retards growth. Larvae of *Celerio lineata*, F., which migrate from other plants, kill seedlings by eating the foliage and stems and can be kept out of the fields by means of barrier ditches. *Laphygma exigua*, Hb., defoliates the plants in May and late July or August; and *Estigmene acraea*, Dru., has caused injury in late summer. *Bucculatrix thurberiella*, Busck, defoliates the plants, causing the bolls to open prematurely and the buds, small bolls and flowers to drop.

Diabrotica undecimpunctata, Mannh. (*soror*, Lec.) is a minor pest and feeds on the foliage, flowers and buds. Germinating seeds and seedlings are attacked by the larvae, and seedlings by the adults, of small Tenebrionids, of which *Blapstinus rufipes*, Casey, is the most important in the San Joaquin Valley; the adults can be controlled by poison bran baits, or by dusting the plants heavily with lime or lightly with calcium arsenate or cryolite, and the seeds can be protected by treatment with organic mercury compounds. The large adults of the Tenebrionid genus *Eleodes* sometimes migrate from pasture and cause localised damage to seedlings, which can be protected with barriers of straw or refuse that is later destroyed, steeply banked loose soil with post holes, ditches containing water or oil and water, or poison baits.

The mites, *Tetranychus bimaculatus*, Harvey, and *T. telarius*, L., feed on the leaves, particularly those of cotton that is well watered or growing near neglected ditches, roadsides, lucerne fields or deciduous fruit trees, and should be controlled by field sanitation or thorough treatment with dusts of sulphur or dinitro-o-cyclohexylphenol.

Brief notes on insects that are of little or no importance on cotton in California and on predacious insects commonly found on it in the San Joaquin Valley, and a list of important cotton pests that are not found in California are appended.

Baker (W. A.) & Bradley (W. G.). **The Colonization of imported Parasites of the European Corn Borer in the United States.**—*Proc. 6th Pacif. Sci. Congr. 1939* **4** pp. 325–333. Berkeley, Calif., 1940. [Recd. 1943.]

An account is given of work done since 1919 on the introduction of parasites against *Pyrausta nubilalis*, Hb., on maize in the United States [*cf. R.A.E.*, **21** 237 ; **26** 729], including descriptions of the methods adopted for their transport from the country of origin and from the laboratory to the field, and of the status of the seven that were established at the end of 1938. A list is given of the 21 species introduced, showing the continent of origin and the stage attacked. The test points at which they were first released for observation were at least 25 miles apart and were selected to provide water, shelter, and a variety of plants as sources of possible food for the adults. A standard colonisation unit, comprising 1,000 females, with males in proportion to the normal sex ratio, was adopted ; in some cases, smaller numbers gave excellent initial results, but colonies of less than 600 adults of both sexes were not considered adequate. Releases were made over a test period of three years, which were not in all cases consecutive. During the course of the work, more than 2,000,000 adult parasites from imported material were made available for release and over 3,000,000 more were reared in the laboratory or obtained from field collections. *Microbracon brevicornis*, Wesm., *Exeristes roborator*, F., and *Chelonus annulipes*, Wesm., were the chief species reared, and those obtained by field collection were principally *Lydella stabulans* var. *grisescens*, R.-D. [the Tachinid also known as *Ceromasia senilis*, Mg.] and *Angitia* (*Inareolata*) *punctoria*, Rom. Over 26,000,000 parasitised larvae of *P. nubilalis* and approximately 770,000 parasite cocoons were received from Europe and the Orient, and, in addition, more than 50,000 adults or pupae of *Phaeogenes nigridens*, Wesm., and over 400,000 hibernating pupae of *Eulophus viridulus*, Thoms., were obtained from Europe. Of the 14 species that have not become established, four were recovered at the time of release, but not subsequently, and four others were Tachinids morphologically identical with native forms and it is possible that these are established, though no marked changes in density have been observed.

At the end of 1938, *L. stabulans grisescens* was well-established in eastern infested areas where *P. nubilalis* has more than one generation a year, and the percentage parasitism at a place in Virginia where a single colony was released in 1935 averaged about 9 over an area 7 miles in diameter and exceeded 20 in several fields. In the Lake States, where the host has only one generation a year, the Tachinid has become established only near Lake Erie, where it is generally distributed over a belt several miles wide and more than 140 miles long by the shore of the lake, but appears to be confined to fields bordering marshland. Parasitism exceeding 80 per cent. was frequently observed at the western end of the lake, and still higher concentrations are expected. Females deposit their larvae at the entrance of tunnels containing host larvae, which are most successfully attacked when in the fourth instar. The parasites overwinter as second-instar larvae.

A. punctoria oviposits chiefly in third-instar larvae and overwinters as a first-instar larva. This Ichneumonid was first released in 1920 in Massachusetts, and by 1938, parasitism over an area of 100 square miles in this State averaged 12·7 per cent. Owing to the ease with which it became established and spread, it was released at many points over the infested area. Nearly 100 colonies had been liberated by 1939, and it is probably more generally distributed than appears from the collections made in 1938. *Macrocentrus gifuensis*, Ashm., which attacks small larvae and overwinters as a partly-developed egg within its host, was imported from Europe in 1926 and from the Orient in 1930, the strain from the Orient proving the more successful. Initial establishment in the Lake States was good but was not maintained. In a district in Massachusetts,

however, where the Oriental strain was released in 1932, it was the most abundant and generally distributed of the imported parasites in 1938, and parasitised an average of 8 per cent. of the larvae of *P. nubilalis* over an area of nearly 2,000 square miles, and more than 50 per cent. in some places. Material was collected from this area for distribution elsewhere, and surveys in the autumn of 1938 showed that initial establishment had occurred in New Jersey.

Chelonus annulipes, which oviposits in the egg and overwinters and develops in the larva of the host, was released annually from 1929 and has been sparingly colonised over the whole infested area. It was not recovered in the Lake States in 1938, but gave percentages of parasitism exceeding 14 in Massachusetts, and was recovered from current releases in New Jersey and Ohio. *Cremastus flavoorbitalis*, Cam., which overwinters as a first-instar larva within the host larva, was released at test points annually from 1929 to 1936. It appears to be established in eastern Massachusetts, where small numbers were recovered in 1938, but not in the Lake States. *Phaeogenes nigridens*, which parasitises the pupae, was first imported in 1924 and released in both the western and eastern areas for a number of years. Small numbers were recovered in Massachusetts in 1937 and 1938. *Eulophus viridulus* was imported from Europe in 1930. It was recovered from current releases at several points, but maintained establishment was not observed until 1938, when small numbers were taken at several points in the Lake States, some more than 9 miles from the nearest release point. It was also found parasitising the indigenous borers, *Pyrausta ainsliei*, Heinr., and *P. penitalis*, Grote, in the field.

BARTLETT (K. A.). **The Collection in Trinidad and southern Brazil of Coccinellids predatory on Bamboo Scales.**—*Proc. 6th Pacif. Sci. Congr. 1939* **4** pp. 339–343, 7 figs., 4 refs. Berkeley, Calif., 1940. [Recd. 1943.]

Details are given of the collection of Coccinellids predacious on the bamboo scales, *Asterolecanium bambusae*, Boisd., and *A. miliaris*, Boisd., in Trinidad and Brazil and on Coccids on *Citrus* in Trinidad and their shipment to Porto Rico, a shorter account of which has already been noticed [*R.A.E.*, A **29** 471]. In a brief discussion of the taxonomy of the introduced species of *Pentilia*, it is stated that the species from Brazil that was previously determined as *P. egena*, Muls., has been identified by E. A. Chapin as *Pentilia* sp. near *egena*. *P. egena* was found in Trinidad, where it was less common on bamboo than on *Citrus*.

FULLAWAY (D. T.). **An Account of the Reduction of the Immigrant Taro Leaf-hopper** (*Megamelus proserpina*) **Population to insignificant Numbers by the Introduction and Establishment of the Egg-sucking Bug** *Cyrtorhinus fulvus*.—*Proc. 6th Pacif. Sci. Congr. 1939* **4** pp. 345–346. Berkeley, Calif., 1940. [Recd. 1943.]

An outbreak of the Delphacid, *Megamelus proserpina*, Kirk., on taro [*Colocasia*] in Hawaii in 1930 was eradicated [*R.A.E.*, A **21** 229] by killing the insects by means of a blow-torch with a flame 4 ft. long, destroying all taro in the district, and suspending its cultivation there for a year. A further outbreak occurred in 1936 in and round Honolulu [**26** 212], and eradication was again effected, but infestations were also discovered in extensive taro-growing areas on the windward side of the island. A less drastic control programme had to be adopted, co-operation among some growers was poor, and by September 1937 the infested areas had greatly extended. The attempt at eradication was therefore abandoned and attention turned to control by natural enemies.

Collections of parasites and predators were made in the Philippines in 1937 and 1938 and shipments sent to Hawaii in both years. Those received there comprised three important parasites, *Paranagrus perforator*, Gir., a species of

Ootetrastichus [subsequently described by Fullaway as *O. megameli* (**29** 280)], and *Gonatopus* sp., and the predacious Capsid, *Cyrtorhinus fulvus*, Knight, which attacks the eggs. The Capsid was liberated as soon as stocks of adults reared in the laboratory became available, and became so well established in all the infested areas that *M. proserpina* is no longer of economic importance there.

Prior to the introduction of *C. fulvus*, another Capsid, *C. mundulus*, Bredd., and the Dryinid, *Haplogonatopus vitiensis*, Perkins, were commonly associated with *M. proserpina* in Hawaii, but exerted little control. *C. fulvus* is believed to feed only on *M. proserpina*, since in experiments adults refused eggs of *Peregrinus maidis*, Ashm., and died, presumably of starvation, and its success as a control agent is attributed to this fact and to the practice of planting taro in blocks, in which heavy infestations of *M. proserpina* are built up. Since *C. fulvus* became established, no other natural enemies of *M. proserpina* have been observed in Hawaii ; C. F. Pemberton reports that *C. mundulus* has similarly replaced *Paranagrus optabilis*, Perkins, which was the most important parasite of the sugar-cane leafhopper [*Perkinsiella saccharicida*, Kirk.] but is now almost extinct. In the Philippines, considerable populations of *M. proserpina* are frequently built up on isolated taro plants before effective parasites and predators appear, and this phenomenon occurs in Hawaii in the case of *C. lividipennis*, Reut., which is being liberated against *Peregrinus maidis* on maize [**28** 461], since the maize plantings are generally small, scattered and seasonal. The establishment of *C. lividipennis* also appears to be hampered by the presence on the plants of large numbers of ants ; these are prevented from hindering *C. fulvus* on taro by the water surrounding the base of the stems.

Graf Marin (A.) & Cortes Peña (R.). **Introducción de hiperparásitos en Chile : resumen de las importaciones hechas y de sus resultados.** [The Introduction of Parasites into Chile against Insect Pests : a Summary of the Importations and of their Results.]—*Proc. 6th Pacif. Sci. Congr. 1939* **4** pp. 351–357, 104 refs. Berkeley, Calif., 1940. [Recd. 1943.]

In 1915–16, the Cleonymid, *Cheiropachys colon*, L., and the Pteromalid, *Rhaphitelus maculatus*, Wlk., were imported into Chile against *Scolytus rugulosus*, Ratz., on pear and stone-fruit trees, but they did not prove of much value and were found in 1938 to be themselves parasitised. In 1921–22, *Aphelinus mali*, Hald., was imported from the United States and Uruguay against *Eriosoma lanigerum*, Hsm., on apple. It has been fairly successful and its distribution in Chile now coincides with that of the Aphid, but the latter begins to breed earlier in spring and develops in abundance from August to blossom time (mid-October), though it then becomes heavily parasitised. In 1931, *Kodolia* (*Novius*) *cardinalis*, Muls., and *Cryptochetum iceryae*, Will., were introduced from California against *Icerya purchasi*, Mask., and have given very good control on *Citrus*. At the same time, *Chilocorus stigma*, Say (*bivulnerus*, Muls.), *Lindorus lophanthae*, Blaisd., and *Orcus chalybeus*, Boisd., were imported against *Aonidiella* (*Chrysomphalus*) *aurantii*, Mask., on *Citrus*, but with little result. In 1933, *Coccophagus modestus*, Silv., *C. ochraceus*, How., *C. trifasciatus*, Comp., *Metaphycus lounsburyi*, How., and *Scutellista cyanea*, Motsch., were imported against *Saissetia oleae*, Bern., on *Citrus* and olive. They have proved of value in the district where they were liberated, but have not spread to any extent. Various mealybugs, including *Pseudococcus citri*, Risso, *P. adonidum*, L., *P. gahani*, Green, and *P. maritimus*, Ehrh., are serious pests of *Citrus*. To combat them, *Cryptolaemus montrouzieri*, Muls., was imported in 1931, *Leptomastidea abnormis*, Gir., in 1931 and 1933, *Coccophagus gurneyi*, Comp., in 1936, and *Leptomastix dactylopii*, How., in 1936 and 1939. These species were all introduced from California and have controlled *P. citri* and *P. gahani* fairly effectively.

Ingram (J. W.), Holloway (T. E.) & Wilson (J. W.). **Recent Developments in Biological Control of *Diatraea saccharalis* in the continental United States.**—*Proc. 6th Pacif. Sci. Congr. 1939* **4** pp. 359–363. Berkeley, Calif., 1940. [Recd. 1943.]

Of the eleven parasites introduced into the United States up to 1937 and liberated against *Diatraea saccharalis*, F., on sugar-cane, a list of which is given, *Microdus* (*Bassus*) *stigmaterus*, Cress., and *Theresia claripalpis*, Wulp, were well-established in 1938 in parts of southern Florida [*cf. R.A.E.*, A **27** 658–659], but none had become established in Louisiana. In 1938, 1,316 mated females of *Lixophaga diatraeae*, Tns., were liberated in a plantation in Florida and the percentage parasitism and infestation later in the season indicated that benefit had resulted [*cf.* **27** 658]. Consignments of adults of *Chelonus annulipes*, Wesm., from Ohio were released in Florida and Louisiana in 1938, but no recoveries were made in the autumn. It was shown experimentally that this Braconid can be reared on *D. saccharalis* under Louisiana conditions.

The Amazon strain of *Metagonistylum minense*, Tns., received in Louisiana from Porto Rico in May 1938, was bred in larvae of *D. saccharalis* in pieces of sugar-cane or in shavings of sugar-cane or maize in galvanised iron pans [**28** 240 ; **29** 354]. Details of the eight generations completed in the laboratory are given in a table. The percentage of parasites that developed decreased with the onset of cold weather, and the stock died out after 5th November, in the ninth generation. Attempts to continue breeding through the winter using field collected puparia were unsuccessful. The parasites were recovered from seven of the eight fields in which they were released in 1938, and from one of them in March 1939 but not later in the year. Adults sent to Florida were released in 1938, but no recoveries were made. Reference is also made to the introduction of the São Paulo strain of the fly in 1939 [*cf.* **29** 354], which was thought to have a better chance of establishment.

Ishii (T.). **The Problems of Biological Control in Japan.**—*Proc. 6th Pacif. Sci. Congr. 1939* **4** pp. 365–367. Berkeley, Calif., 1940. [Recd. 1943.]

Attempts to control injurious insects in the Japanese Empire by means of imported natural enemies have been made since 1909. The species that have become established and afford effective control are *Rodolia* (*Novius*) *cardinalis*, Muls., which was introduced into Formosa from California and Hawaii in 1909, against *Icerya purchasi*, Mask., and thence into Shizuoka Prefecture against the same Coccid in 1910 ; *Prospaltella smithi*, Silv., a parasite of *Aleurocanthus spiniferus*, Quaint., that was imported from China in 1925 [*R.A.E.*, A **15** 463] and has completely controlled this Aleurodid in Kyushu, where it was an important pest of *Citrus* ; and *Aphelinus mali*, Hald., which was introduced into Japan from Oregon against the woolly apple aphis [*Eriosoma lanigerum*, Hsm.] in 1933 [**26** 771]. Insects that have been introduced into Japan but have not become established include *Spathius fuscipennis*, Ashm., and *Trichogramma* sp., which are important parasites of *Chilo simplex*, Btlr., in the Philippines and were imported in 1928–30 ; *Uscana semifumipennis*, Gir., imported from Hawaii against *Bruchus* spp. in 1931 ; *Macrocentrus ancylivorus*, Rohw., *Glypta rufiscutellaris*, Cress., and *Pristomerus ocellatus*, Cushm., imported from the United States against *Cydia* (*Laspeyresia*) *molesta*, Busck, on peach in 1933 ; *Aneristus ceroplastae*, How., a parasite of *Ceroplastes rubens*, Mask., which has been imported from Hawaii several times since 1932 ; and *Cryptolaemus montrouzieri*, Muls., which was introduced against *Pseudococcus adonidum*, L. (*longispinus*, Targ.) on *Citrus*, and *P. kraunhiae*, Kuw., on persimmon in 1931 [**20** 606]. *Telenomus* (*Phanurus*) *beneficiens*, Zhnt., and an unidentified species of the same genus, which parasitise the eggs of the sugar-cane borers, *Chilo infuscatellus*, Sn., *Scirpophaga nivella*, F., and *Eucosma schistaceana*, Sn., were imported into Formosa from Java in 1915, but also did not become established.

Thripoctenus brui, Vuillet, a parasite of the onion thrips [*Thrips tabaci*, Lind.], is fairly common near Tokyo and has for several years been shipped to Hokkaido, but has not become established there.

FLANDERS (S. E.). **The practical Application of Biological Studies on Parasites employed in Biological Control.**—*Proc. 6th Pacif. Sci. Congr. 1939* **4** pp. 373–381, 44 refs. Berkeley, Calif., 1940. [Recd. 1943.]

The author points out the importance of conducting detailed studies on the bionomics of parasites used in the control of insect pests in order to increase the proportion of successful liberations and render the method of wider application. He reviews from the literature recent studies that have important bearings on the practice of biological control and deal with the factors regulating population densities, the ability of individual parasites to find hosts and the influence of this ability on the specificity of their attack, the effect of environment on the adaptation of a parasite to its normal host, the correlation of the ovarian development of a parasite with its dispersal, the influence of the feeding habit of the adult parasite on the localisation of parasitism, the effect of artificially retarded development on the fecundity of parasites, the effect of food on the occurrence of diapause, the artificial regulation of the sex ratio, the effect of intraspecific hyperparasitism on parasite propagation and establishment, and the effect of geographical isolation on the reproductive capacity and life-history of parasitic species.

OTANES (F. Q.). **A Survey of Philippine Entomology, with special Reference to applied or economic Work.**—*Proc. 6th Pacif. Sci. Congr. 1939* **4** pp. 383–396, 3½ pp. refs. Berkeley, Calif., 1940. [Recd. 1943.]

This paper comprises a brief review of publications on insects occurring in the Philippines that were issued while the Islands were under Spanish dominion, when very little work on economic entomology was done, and a more detailed survey of the work that has been carried out since and the organisations concerned in it. Reference is made to various subjects that were under investigation in 1939.

MICHELBACHER (A. E.). **The Value of accurate Classification of Insects as illustrated by the Confusion of two closely related Species of** *Hypera*.—*Proc. 6th Pacif. Sci. Congr. 1939* **4** pp. 403–405, 7 refs. Berkeley, Calif., 1940. [Recd. 1943.]

In stressing the importance of taxonomy to economic entomology, the author refers to the recent discovery that *Hypera variabilis*, Hbst. (*postica*, Gylh.) and *H. brunneipennis*, Boh., have been confused in North Africa [*R.A.E.*, A **29** 403]. This resulted from attempts to determine the southernmost limits to which the infestation of lucerne by *H. variabilis* in California might be expected to extend and the finding that the weevil attacking lucerne in Arizona was not *H. variabilis* but *H. brunneipennis* [*cf. loc. cit.*]. He states in a footnote that he was informed by A. S. Hassen in July 1939 that recent surveys in Egypt have shown that *H. brunneipennis* is the dominant species there, *H. variabilis* being confined to the Mediterranean coastal region.

ESAKI (T.). **A preliminary Report on the entomological Survey of the Micronesian Islands under the Japanese Mandate, with special Reference to the Insects of economic Importance.**—*Proc. 6th Pacif. Sci. Congr. 1939* **4** pp. 407–415. Berkeley, Calif., 1940. [Recd. 1943.]

This report comprises brief notes, based on observations in 1936–38, and many of the pests of crops have already been noticed [*cf. R.A.E.*, A **25** 335,

712 ; **28** 259, 266]. Others include *Planispa chalybeipennis*, Zacher, *Eobia* spp., *Callirhipis* sp., and several termites and Coccids on coconut ; *Eucosma* (*Laspeyresia*) *schistaceana*, Sn., *Pseudococcus brevipes*, Ckll., and *Proutista* (*Phenice*) *moesta*, Westw., on sugar-cane ; *Aphis maidis*, Fitch, on maize ; *Leptocorisa varicornis*, F., and *Nezara viridula*, L., on rice ; *Precis vellida*, F., and *Herse convolvuli*, L., on sweet potato ; *Saissetia nigra*, Nietn., on cassava ; *S. nigra* and *Pinnaspis minor*, Mask., on egg-plant [*Solanum melongena*] ; *Earias cupreoviridis*, Wlk., *N. viridula* and *Leptoglossus membranaceus*, F., on cotton ; *Heliothis* (*Chloridea*) *assulta*, Gn., and *Prodenia litura*, F., on tobacco ; *Ischnaspis longirostris*, Sign., and *Pulvinaria psidii*, Mask., on coffee ; *Riptortus* sp., *N. viridula* and *Halticus tibialis*, Reut., on beans ; *H. tibialis*, *Aphis gossypii*, Glov., *Aulacophora quadrimaculata*, F., *Margaronia indica*, Saund., and *Prodenia litura* on cucurbits ; *P. litura* and *Bemisia tabaci*, Gennadius, on cabbage ; *Thrips tabaci*, Lind., on onion ; *Megamelus proserpina*, Kirk., and Sphingids of the genera *Hippotion* and *Theretra* on taro [*Colocasia*] ; *Papilio xuthus*, L., and *Agrilus auriventris*, Saund., on *Citrus* ; *Dacus* (*Chaetodacus*) *ferrugineus* var. *dorsalis*, Hend., on *Citrus* and mango ; *Heliothrips haemorrhoidalis*, Bch., on mango and avocado ; *Aspidiotus destructor*, Sign., and *Coccus viridis*, Green, on banana ; *Pseudococcus brevipes* and *Pseudischnaspis anassarum*, Ldgr., on pineapple ; *Xenaleyrodes artocarpi*, Takah., on breadfruit [*Artocarpus communis*] ; and a number of Coccids on breadfruit, papaya, soursop [*Annona muricata*], sweetsop [*A. squamosa*] and avocado.

Baird (A. B.). **Laboratory Propagation of Parasites and its Place in Biological Control Programs.**—*Proc. 6th Pacif. Sci. Congr. 1939* **4** pp. 417–420. Berkeley, Calif., 1940. [Recd. 1943.]

The author enumerates the conditions that render desirable the mass propagation in the laboratory of parasites of insect pests for distribution in the field and the advantages to be derived from the use of such controlled stock. He emphasises the desirability of making comprehensive studies on the bionomics of these parasites so that they may be handled in such a manner that maximum control is obtained from them, that laboratory techniques enabling artificial propagation to be carried out more economically than field collections may be developed, and that laboratory stocks, which, contrary to previous belief, are not gradually weakened by prolonged laboratory culture, may be improved. He also draws attention to the increased facilities for the shipment of parasites and predators provided by improved transport, particularly by air.

Clausen (C. P.). **Some Factors relating to Colonization, Recovery, and Establishment of Insect Parasites.**—*Proc. 6th Pacif. Sci. Congr. 1939* **4** pp. 421–428, 7 refs. Berkeley, Calif., 1940. (Recd. 1943.]

The author discusses, with special reference to the development of method, some of the problems encountered in the course of work on the introduction of parasites and predators against insect pests. They include the question of whether stocks for liberation shall be imported or reared in the laboratory, and if the latter, the selection of suitable breeding hosts, the size and spacing of colonies, and the period for which attempts to establish a given species should be continued. Considerable influence is exerted on establishment by the conditions of light and temperature at the time of release. Adults sometimes disperse widely and quickly when liberated in bright sunlight and at relatively high temperatures, thus reducing opportunities for mating among the individuals released and among their progeny and perhaps removing a large proportion of the colony from a small favourable area to others that are unfavourable. W. A. Baker has observed the immediate death of adults of certain parasites of the European corn borer

[*Pyrausta nubilalis*, Hb.], notably *Macrocentrus gifuensis*, Ashm., when released under these conditions in the United States. This is attributed to physical shock caused by the sudden transition from the moderate temperatures (45–60°F.) and diffused light or darkness in which the parasites are kept before release to temperatures often exceeding 100°F. and intense sunlight. Where species released under such conditions have survived and become established, it is probable that still more satisfactory results would be obtained if they were released under more favourable conditions. To overcome these difficulties it is suggested that releases should be made at dusk or at dawn, when activity would be reduced by the cool temperatures and dim light, and the tendency to disperse checked. Further advantages derived from liberations at dusk are the opportunity afforded by the night for the insects to recover from the effects of transport and to become accustomed to their new surroundings and for gradual adjustment to increasing light and temperature.

NGAYEN-CONG-TIEN. **Le vôi** (*Eugenia operculata* **Roxb.**).—*Proc. 6th Pacif. Sci. Congr. 1939* **4** pp. 719–725, 13 figs. Berkeley, Calif., 1940. [Recd. 1943.]

This account of the cultivation of *Eugenia operculata* in Indo-China, and the ways in which its leaves and flower buds are dried, fermented and used to prepare an infusion for drinking, includes a note on insects that attack the young trees. They comprise the Lasiocampid, *Trabala vishnou*, Lef., the Noctuid, *Carea subtilis*, Wlk., and the weevil, *Apoderus bilineatus*, Faust. *T. vishnou* feeds on the leaves, especially in April, May and June, often rendering them useless, but is less injurious than *A. bilineatus*, which cuts and rolls the leaves. *C. subtilis* causes little damage.

OCFEMIA (G. O.). **Geographical Distribution of Virus Diseases of Plants with special Reference to the Philippines.**—*Proc. 6th Pacif. Congr. 1939* **4** pp. 745–748, 22 refs. Berkeley, Calif., 1940. [Recd. 1943.]

The following is largely the author's summary. Fiji disease of sugar-cane [*Galla fijiensis* of Holmes], which is transmitted in the Philippines by *Perkinsiella vastatrix*, Bredd., and in Australia by *P. saccharicida*, Kirk., occurs in Australia, Fiji, the Philippines, and perhaps New Guinea and Java. Mosaic of sugar-cane [*Marmor sacchari* of Holmes] is found in all countries in which sugar-cane is grown, with the possible exception of Mauritius. The virus can be transmitted by sap extract and by *Aphis maidis*, Fitch, *Carolinaia* (*Hysteroneura*) *setariae*, Thos., and *Toxoptera graminum*, Rond.

The bunchy-top viruses that infect species of the genus *Musa* are transmitted by the Aphid, *Pentalonia nigronervosa*, Coq. The bunchy-top of Manila hemp (*Musa textilis*) in the Philippines is caused by a virus [*Marmor abaca* of Holmes] distinct from that which infects bananas, plantains, Manila hemp and wild species of *Musa* in Australia. The Philippine bunchy-top is confined to Manila hemp and is also distinct from the infectious chlorosis of banana in Australia. The Australian bunchy-top occurs in Australia and Fiji and perhaps in Ceylon and Egypt. The infectious chlorosis of banana in Australia is perhaps identical with the mosaic that occurs in Manila hemp and wild *Canna* in the Philippines [*cf. R.A.E.*, A **29** 57], which is transmitted by *Aphis gossypii*, Glov., and two other Aphids [*cf.* **29** 317] and by contact.

[NEGI (P. S.).] **Entomological Section.**—*Rep. Indian Lac Res. Inst. Namkum 1941–42* pp. 12–23. Ranchi, 1942.

Aonidiella (*Aspidiotus*) *orientalis*, Newst., was not prominent on the host trees of *Laccifer lacca*, Kerr, at Namkum, Bihar, in 1941–42, and *Tessaratoma javanica*, Thnb., was controlled on *Schleichera trijuga* by hand-picking. The

weevil, *Pachyonyx quadridens*, Chevr., which causes galls on the petioles of *Butea frondosa*, was fairly numerous in Kundri. The fifth generation of the parthenogenetic strain of *L. lacca* [*cf. R.A.E.*, A **30** 381] began to develop satisfactorily. The insect was attacked by the same species of predators and parasites as in previous years [*cf.* **29** 263] ; the average percentage parasitism was 4·6–8·0 in three crops in the Institute plantation, but had fallen from 53·3 to 41·5 in one crop in another district of Bihar [*cf.* **30** 381]. All the crop except that selected for brood should be immersed in running water or more than 2 ft. below the surface of stagnant ponds for three days before it is scraped, to prevent the emergence of natural enemies, and brood lac should be treated similarly after the larvae have left it. This treatment also makes the scraping of lac easy, reduces the quantity of dust in the scraped lac, and has no adverse effect on the manufacture of shellac or the physical and chemical properties of the manufactured product. Applying water or normal salt solution to eggs of *Eublemma amabilis*, Moore, that were parasitised by *Trichogrammatoidea nana*, Zhnt., or *Trichogramma minutum*, Ril., did not appear to facilitate the emergence of the adult parasites [*cf.* **30** 382]. Other parasites of lac predators observed during the year and not recorded in recent reports [**30** 382, etc.] included a species of *Perisierola* and an unidentified Elasmid attacking larvae of *Holcocera pulverea*, Meyr., *Elasmus claripennis*, Cam., attacking those of *Eublemma*, *Brachymeria tachardiae*, Cam., attacking pupae of both species, *Eurytoma pallidiscapus*, Cam., and *Apanteles fakrulhajiae*, Mahdn. The results of experimental liberations of *Microbracon greeni*, Ashm., against *Eublemma* and *M. hebetor*, Say, against both predators, which are shown in tables, indicated that releases of *M. greeni* were of some value.

Braithwaite (J. D.). **Notes on Research into the Parasite of the Bee-hole Borer of Teak.**—*Emp. For. J.* **21** no. 2 pp. 120–122. London, 1942.

Investigations by previous workers in Burma have shown that the percentage parasitism of larvae of *Xyleutes ceramicus*, Wlk., on teak [*Tectona grandis*] by the Ichneumonid, *Nemeritis tectonae*, Perk., decreased with increasing height and age of the trees [*cf. R.A.E.*, A **29** 76], so that it appeared unlikely that this Cossid could be controlled effectively by it. Further investigation showed, however, that in the case of the older trees, a high proportion and sometimes all of the parasitised larvae occurred in the crown wood, and that the percentage parasitised in the crown of a large tree was not much lower than the percentage in a small tree. It is therefore considered that it may be preferable to grow teak under the selection system, so that the crown of a small tree would be next to the bole of a teak tree, and parasites from the crown of the small tree would be available to parasitise the larvae in the bole of the adjacent one.

In order to obtain a stock of larvae of the Cossid for breeding the parasite, eggs from moths caught at Zibingyi were placed on the bark of selected trees and enclosed by cages made of tins split lengthwise and fitted with a hinge so that they closed round the bole ; gaps were sealed with paraffin wax. In June–July 1940, adults of *N. tectonae* bred from larvae taken in a heavily parasitised area were allowed to pair and the females induced to oviposit in the larvae reared in the cages. Each laid about 60 eggs, and some 400 larvae were parasitised. Only 7 adult parasites were obtained, however, the life-cycle lasting about 6 weeks. *N. tectonae* apparently prefers to parasitise *X. ceramicus* in June, when the larvae are fairly small and are just beneath the bark, so that they are easily reached by the females. It is not certain how many generations the parasite has in a year or what its hosts are when larvae of *X. ceramicus* are too deep in the wood to be reached, but it is likely that they are larvae of *Indarbela* on pyinkado [*Xylia dolabriformis*] and teak [*cf.* **30** 93]. The larvae of *Indarbela* are surface borers and can be reached at almost any season. *Indarbela* has one generation a year, pupating in February and emerging in March, and the full-grown larvae are about as long as the larvae of *X. ceramicus* in June.

During pairing experiments with adults of *X. ceramicus* in March–April 1940, it was observed that the females often produced from the ovipositor a white fluid that appeared to attract the males.

GADD (C. H.). **The Effect of Plucking on Shot-hole Borer Attack in Tea.**—*Tea Quart.* **15** pt. 2 pp. 31–40, 1 graph, 6 refs. Talawakelle, 1942.

Observations on the course of infestation by *Xyleborus fornicatus fornicatior*, Egg., in tea bushes at an elevation of 3,500 ft. at Passaro, Ceylon, that had been pruned in November or December 1938 and subjected to light or heavy plucking from 12th May 1939 until 29th September 1941 [*cf. R.A.E.*, A **30** 319, 509] were continued between 9th October and 3rd December 1941, and the results for the whole period are given and discussed. They indicated that the rate of increase in the total number of galleries was approximately the same for the two types of plucking, but the number of occupied galleries increased less rapidly in the heavily plucked plots, either because the galleries were occupied for a shorter time or because more of them were abandoned by the beetles without being used for breeding. It was calculated that the mean time of occupation was 7–9 weeks for lightly plucked bushes and 5–8 weeks for heavily plucked ones, the period decreasing as the time from pruning increased. The yield from the heavily plucked plots was significantly greater than that from the others, but this is attributed to the type of plucking and not to diminished attack by the borer. The beetle population ceased to increase some time after the end of November 1940 and later decreased until it was almost insignificant by October 1941, towards the end of the third year from pruning [*cf.* **30** 509]. Possible physiological reasons for the cessation of attack are discussed.

ULLYETT (G. C.) & SCHONKEN (D. B.). **A Fungus Disease of *Plutella maculipennis*, Curt., in South Africa, with Notes on the Use of entomogenous Fungi in Insect Control.**—*Sci. Bull. Dep. Agric. For. S. Afr.* no. 218, 24 pp., 8 figs., 26 refs. Pretoria, 1940. [Recd. 1943.]

In the course of a study of the natural control of *Plutella maculipennis*, Curt., on cabbage in the Transvaal, observations were made on the incidence and effect of a fungous disease of the larvae caused by *Entomophthora sphaerosperma*, which appears in the field sporadically and cannot be regarded as a permanent member of the complex of parasites associated with *Plutella*. Notes are given on the Entomophthoraceae and the species of *Entomophthora* pathogenic to insects, and the hosts and distribution of the more important of these are shown in a table. The way in which *E. sphaerosperma* infects and develops in the larvae of *P. maculipennis* and the reactions of the larvae to infection are discussed, and methods of culturing the fungus artificially and inoculating the larvae are described. From a discussion of the effect of environmental factors, particularly humidity and temperature, on the fungus, and of the fungus on insect parasites and predators and on the population of *Plutella*, it is shown that the fungus reduces the population of parasites and predators by causing a lack of hosts and also affects the parasites directly, and that, although it produced a considerable immediate reduction in the host population during the favourable weather conditions under which it acted, it was ultimately responsible for an increase in the average density of the host, and, through this, for the occurrence of economic damage to the crop.

The use of entomogenous fungi in insect control is discussed in general, and it is concluded that since, except in special areas, fungi afford only a temporary reduction comparable to that given by insecticides, they cannot normally be considered as agents of biological control, which aims at the stabilisation of a pest population at an average density that will not allow economic damage to the crop.

VRYDAGH (J. M.). **Etude sur la biologie de** *Dysdercus superstitiosus* **F. (Hemiptera).**—*Publ. Inst. Etude agron. Congo belge* Sér. sci. no. 24, 19 pp., 2 graphs, 1 fig., 17 refs. Yangambi, 1941. Price *Fr.* 15. [Recd. 1943.]

The species of *Dysdercus* found by the author on cotton at Bambesa, Belgian Congo, were *D. superstitiosus*, F., which was far the most abundant, *D. nigrofasciatus*, Stål, *D. melanoderes*, Karsch, *D. haemorrhoidalis*, Sign., which was rare, and *D. cardinalis*, Gerst., of which only one example was taken and which had not previously been recorded in the Belgian Congo. A key to the first four is given. Both the nymphs and the adults disseminate the fungi, *Nematospora* (*Ashbya*) *gossypii* and *N. coryli*, which destroy the interior of the boll and cause the loss of a considerable part of the crop.

D. superstitiosus was bred in Petri dishes containing fresh cotton seeds and wet cotton-wool at a temperature of about 25°C. [77°F.] and a relative humidity of 96–100 per cent. Male and female adults lived for averages of 33 and 23 days, respectively. Pairing, which lasted 3–5 days, occurred 3–6 days after the final moult, but was inhibited by lack of food. At 30°C. [86°F.] and 90 per cent. humidity it occurred 2–3 days after the moult. Females in the field oviposit in the soil and in heaps of cotton seed. Those in the laboratory preferred soil to seed, and always selected a moist position. On an average, they oviposited 8·6 days after the final moult and then at intervals of about 4 days until death and deposited 292·75 eggs (with a maximum of 447) in 3·3 batches each containing about 84 eggs, with a maximum of 135. Pairing was repeated after each batch was deposited. At 25°C. and 95 per cent. humidity, 94 per cent. of the eggs hatched, in an average of 5·75 days, while at 30°C. and 95 and 72 per cent. humidity, 100 and 59 per cent. did so, in averages of 4 and 4·05 days. There must be considerable mortality of eggs that are laid in the soil, since they occur at a depth of only about 1 cm. and are subject to wide daily variations in temperature and humidity. At Bambesa, daily differences of up to 34·5°C. [62·1°F.] were registered at this depth in the soil in December–February. The relative humidity was practically 100 per cent. from 7 p.m. to 6 a.m. and then decreased to a minimum at 2 p.m., the lowest recorded being 14 per cent. The egg and nymphal stages lasted 6 and 26 days, respectively, at 25°C., and these figures are compared with those obtained in other parts of Africa [*R.A.E.*, A **12** 67; **21** 484; **26** 373]. At 30°C., the egg and nymphal stages averaged 4 and 18·85 days. From the data obtained a curve is drawn by the method of Blunck & Bodenheimer showing the effect of temperature on development, and it is apparent from it that there is a great increase in the duration of development below 25°C., so that *D. superstitiosus* is thermophilous. Its distribution in the hotter parts of Africa depends on humidity; it is restricted to places where water is available throughout the year, and is replaced in the drier regions by *D. fasciatus*, Sign.

The banded form of *D. superstitiosus* recorded from Nigeria [**16** 233, 234] was observed at Bambesa on *Pachira aquatica* and another malvaceous plant, but not on cotton.

VRYDAGH (J. M.). **Etude de l'acariose du cotonnier, causée par** *Hemitarsonemus latus* **(Banks) au Congo Belge.**—*Publ. Inst. Etude agron. Congo belge* Sér. sci. no. 28, 25 pp., 6 figs. 25 refs. Yangambi, 1942. Price *Fr.* 20.

Tarsonemus (*Hemitarsonemus*) *latus*, Banks, all stages of which are described, was found on cotton in the Belgian Congo, where it had not previously been recorded, in 1936, and observations in 1939 and 1941 showed that infestation was widespread in the northern savannah districts. It was also found infesting *Capsicum annuum*, rubber (*Hevea brasiliensis*), castor (*Ricinus communis*), potato, sweet potato, and other plants, and a list of its recorded food-plants is included. On cotton the mites live chiefly on the lower surfaces of the leaves

and feed on the epidermis. Infested leaves curl, develop brown patches and split, but do not drop prematurely. Infested cotton plants have unusually long internodes, develop few bolls and are practically sterile. The injury is similar to the leaf-curl of cotton recorded by Jones & Mason in Nigeria [*R.A.E.*, A **16** 376] and to that caused by *T. latus* and described by Hambleton in Brazil [**28** 11]. The life-cycle lasted 4½ days in the laboratory at 24°C. [75·2°F.]. The females oviposited on the lower surfaces of the leaves, beginning mostly 1–2 days after emergence, and deposited 6–33 eggs at the average rate of 3 a day. Pairing did not influence oviposition, but eggs laid by unfertilised females gave rise to males only. The process of pairing is described, and the significance of the habit of the males of transporting the nymphs is discussed. The mite is favoured by wet weather with abundant soil moisture and is rare during the dry season.

Lefèvre (P. C.). **Quelques observations sur** *Celerio nerii* **L.**—*Bull. agric. Congo belge* 1942 no. 3–4, repr. 7 pp., 3 refs.; also in *Centre Afr.* 1942 no. 468 p. 13, 3 refs. Costermansville, 1942.

Larvae of the Sphingid, *Deilephila* (*Celerio*) *nerii*, L., all stages of which are briefly described, feed on the leaves, leaf-buds and tips of the branches of *Cinchona* spp. in the Belgian Congo; in Kivu, they chiefly infest *C. succirubra*. They are most abundant at the end of the rainy season. The eggs are laid on the leaves, and in the laboratory, the egg, larval and pupal stages lasted 12, 25 and 25 days, respectively. A Tachinid, *Actia cibdella*, Villen., parasitised up to 25 per cent. of the larvae in one locality; the parasite larvae emerged from their hosts when these were 13–23 days old, and the pupal stage lasted 2–3 weeks. In one instance, 16 emerged from a single host. Dusting with a mixture of pyrethrum and ash against the Capsid, *Helopeltis orophila*, Ghesquière, on *Cinchona* keeps the population of *D. nerii* at a low level. In case of a sudden outbreak of the latter, it would be advisable to apply the dust while the larvae were still quite young.

Scott (J.). **Note on Tobacco Seed Beds. Control Measures against Ravages of Black Ants.**—*Rhod. agric. J.* **40** no. 1 pp. 16–18. Salisbury, S. Rhod., 1943.

Much loss was caused in 1940 on seed-beds of Virginia tobacco on a plantation in Southern Rhodesia by ants that carried away the seeds and germinating seedlings. Poisoned baits caused no evident reduction in the infestation, the application of poisons to the nests was abandoned, as it required constant supervision and the area to be treated was too large, and repellents tried for seed treatment killed the seed or failed to affect the ants. The last sowings, however, were successfully protected by covering the beds immediately after sowing with a thin layer of sand. Experiments in 1941 showed that a ½-inch layer of river sand was the smallest quantity that gave full protection. Before being used, the sand was spread in a shallow pit, 4 ins. deep, thoroughly covered with brushwood and burnt to destroy weed seeds and Nematodes. The beds were thoroughly watered after it had been applied.

Doucette (C. F.), Latta (R.), Martin (C. H.), Schopp (R.) & Eide (P. M.). **Biology of the Narcissus Bulb Fly in the Pacific Northwest.**—*Tech. Bull. U.S. Dep. Agric.* no. 809, 66 pp., 28 figs., 39 refs. Washington, D.C., 1942.

The following is based on the authors' summary. *Merodon equestris*, F., all stages of which are described, has become one of the major pests of narcissus in the bulb-producing areas in Washington and Oregon. The eggs are laid

at the base of the foliage or in cracks in the soil nearby, and generally hatch in 10–12 days. The life-cycle normally lasts one year. Newly hatched larvae enter the bulbs late in May and in June and pass through three instars, becoming full-fed by late September or October. They leave the bulbs early in spring and pupate close to the soil surface, and the adults emerge in May and June. For some individuals, larval development is retarded during the first summer, and these pass the first winter in the early second or occasionally the early third instar, continue to develop during the second spring and summer, become full-fed in the middle of summer or towards autumn, and leave the bulbs and pupate in the following spring. The larvae usually enter the bulbs through the root ring into the basal plate, where they feed for some time, tunnelling through the tissue, and later they burrow upward into the scale region, eventually consuming a large part of the bulb. There is usually only one larva in a bulb, but occasionally two may be present and rarely three or four ; single records of five, six and eight have been noted.

Narcissus is the principal economic food-plant, but infestation has been recorded in a number of bulbous plants, a list of which is given, and some of these may become food-plants of general importance. The average percentage infestation of narcissus in the Pacific Northwest ranged between 2·5 and 4·5 during the seasons 1934–40, and the financial loss in this region is estimated at $80,000 to $100,000 per year. No positive preference for particular narcissus varieties has been observed, though indications have been noted that the fly may prefer certain varieties under certain conditions. Depth of planting and the type of soil have some influence on the amount of infestation, and it has been observed that the percentage of bulbs infested is higher if they are large or are on the margins of plantings. Larval mortality in the early stages is considerable and has averaged 25–51 per cent. of individuals that have entered the bulbs in commercial stocks. In 1926, 27 of 206 pupae from bulbs that had been forced in a greenhouse were parasitised by the Ichneumonid, *Rhembobius abdominalis*, Prov. Birds may possibly find and destroy a small number of pupae, but natural enemies have not yet become of importance in the Pacific Northwest.

French (O. C.). **Spraying Equipment for Pest Control.**—*Bull. Calif. agric. Exp. Sta.* no. 666, 42 pp., 31 figs., 6 refs. Berkeley, Calif., 1942.

In this bulletin, the fundamental principles of modern spraying equipment are explained. A section dealing with the basic mechanics of sprayers, in which the characteristics of different types of pumps, pressure regulators, nozzles, guns and rods are described and illustrated, and methods of agitating and atomising the spray and the effect of pressure and its loss in hose and rods are discussed, is followed by others containing detailed information on portable power sprayers, stationary spray plants, portable pipe-line systems, air atomising sprayers and weed sprayers.

Huckett (H. C.). **Spraying and Dusting Experiments with Bush Lima Beans on Long Island for Control of the Mexican Bean Beetle.**—*Bull. N. Y. St. agric. Exp. Sta.* no. 702, 45 pp., 3 figs., 17 refs. Geneva, N.Y., 1942.

The author summarises the results of field experiments on Long Island in 1936–41 to determine the relative effectiveness of sprays and dusts containing pyrethrum and rotenone-bearing dusts against *Epilachna varivestis*, Muls., on lima beans and their compatibility with alkaline fungicides. A short account is given of the seasonal activity of this Coccinellid [*cf. R.A.E.*, A **30** 360], which was very harmful in the first three years, injuring foliage, flowers and pods, much less injurious in 1939, owing to reduction in its numbers under drought conditions, and of little, if any, importance in 1940 and

1941. The sprays and dusts used and the methods of applying them and of assessing the results are described. The sprays contained skim-milk powder, wettable sulphur, or copper oxychloride or Bordeaux mixture with a wetting agent, with or without the addition of 4 lb. derris, cubé or timbo per 100 U.S. gals. (0·019–0·0262 per cent. rotenone) or 8 or 4 lb. pyrethrum per 100 U.S. gals. (0·009 and 0·0045 per cent. pyrethrins). The dusts consisted of sulphur, copper oxychloride with talc and monohydrated copper sulphate with hydrated lime, with or without the addition of 10 per cent. derris, cubé or timbo dust (to give 0·475–0·59 per cent. rotenone) or pyrethrum dust (to give 0·54 and 0·49 per cent. pyrethrins), or the same insecticides with clay or talc ; limited tests were made with impregnated dusts containing 0·2 per cent. pyrethrins or 0·12 per cent. rotenone. During 1936–39, copper sprays, particularly those containing Bordeaux mixture, gave a high degree of foliage protection, and, except in 1936, satisfactory yields ; the addition of rotenone or pyrethrum improved foliage protection slightly, but did not always increase the yield. In most seasons, the greatest increases in yield were obtained with sprays containing rotenone and wettable sulphur or skim-milk powder, although they were less effective than copper sprays in protecting foliage. Sprays of wettable sulphur without an insecticide were consistently less effective than the corresponding copper sprays, and those containing wettable sulphur or skim-milk powder with pyrethrum were inferior to similar sprays containing rotenone. There was no indication that the effectiveness of treatment with insecticide and Bordeaux mixture might be improved by applying the fungicide and insecticide separately, or that stabilised rotenone-bearing powder might be more effective than standard rotenone-bearing powder under field conditions. There was practically no difference in the effectiveness of sprays containing copper oxychloride or Bordeaux mixture. Dusts were less effective than sprays in most cases and gave less consistent results. Dusts containing rotenone were more effective than those containing pyrethrum or no insecticide, and those containing copper sulphate and lime were rather better than corresponding ones containing sulphur ; the addition of rotenone to the dusts of copper sulphate and lime improved foliage protection, but had practically no effect on yield. In 1940 and 1941, sulphur treatments were consistently more beneficial than others, and considerably improved the yield in some cases, and pyrethrum tended to give better yields than rotenone. Plots treated with sprays of the two copper compounds showed little benefit and sometimes actual loss ; copper dusts were less harmful than copper sprays.

The author recommends the use of 4 lb. derris, cubé or timbo (5 per cent. rotenone) in 100 U.S. gals. spray or 40 lb. dust, with the addition of sulphur if infestation by *Tetranychus* spp. or *Empoasca fabae*, Harr., is likely, or of a copper compound if it is advisable to protect the crop from fungous diseases. One or two applications should be made when adults are most numerous and oviposition most prolific, at which times there is a notable increase in the extent of foliage injury by recently hatched larvae, and one or more during the intervals between such peaks. A rotenone-bearing dust with monohydrated copper sulphate and lime must be applied immediately after mixing.

Current Contributions on Insect Control : II.—*Bull. N. Y. St. agric. Exp. Sta.* no. 703, 64 pp. Geneva, N.Y., 1943.

This bulletin contains the following reports of investigations in progress in New York State.

Huckett (H. C.). **The Control of the Common Red Spider on Lima Beans,** pp. 5–7, 1 fig. *Tetranychus bimaculatus*, Harvey, sometimes damages lima beans on Long Island, particularly in well-drained fields near woodland or waste land. In experiments in 1942, sprays containing 12 lb. wettable sulphur per 100 U.S. gals., alone or with 4 lb. cubé powder, and dusts of 50 per cent. sulphur,

alone or with 10 per cent. cubé powder, were applied 4 times at intervals of 10–12 days, beginning on 25th June, a month after sowing, and proved extremely effective. Proprietary compounds of dinitro-ortho-cyclohexylphenol in sprays and dusts gave satisfactory but more variable protection, and sprays and dusts containing cubé powder without sulphur were ineffective. Control of the mite improved the condition of the foliage and the total yield of marketable pods and their quality.

GAMBRELL (F. L.). **Observations on the economic Importance and Control of the European Chafer,** pp. 8–13, 1 fig., 3 refs. Investigations on the injury caused by *Amphimallus* (*Amphimallon*) *majalis*, Razoum., which occurs over at least 50 sq. miles in western New York [*cf. R.A.E.*, A **31** 21], showed that the larvae damage the roots of grasses and also of certain weeds and perennials and of seedlings of pine and spruce ; a list of the plants attacked is given. Damage to the leaves of trees and shrubs by the adults was negligible. The life-cycle lasts a year. The adults emerged from the soil in June and early July ; oviposition was first observed on 20th June in 1942 and hatching on 6th July. The beetles spend the day in the soil, fly at dusk and rest on trees during the night. An average of 71·8 per cent. of those shaken from trees after dark were males. Most larvae occurred within the top two inches of soil in autumn and spring, but were below the frost line during winter. As the available food-supply diminished, they moved to other plants, the number in good turf adjacent to dead or dying turf being usually higher than in the latter. The date of pupation varied with local conditions ; in fine sandy loam, all larvae had pupated by 30th May, whereas in areas of heavier soil and noticeable ground cover, 4 per cent. had not pupated by 27th June. The depth varied from two to eight inches, depending to some extent on the soil type. Under field conditions, the pupal stage lasted 14–15 days. Many larvae were destroyed by birds and small mammals.

In preliminary tests, treatment of the soil with lead arsenate at the rate of 1,500 lb. per acre in May 1940 gave effective control of an infestation averaging 7·2 larvae per sq. ft. ; and treatment in 1942 of young spruce trees, with balls of earth 10–14 ins. in diameter wrapped in burlap and artificially infested with *Amphimallus* larvae, by immersing the balls in emulsions of 0·6 or 1·2 per cent. ethylene dichloride for 10 seconds at 54°F. gave complete mortality of larvae within the balls and a high kill of those on the surface.

DEAN (R. W.). **Rotenone for Apple Maggot Control,** pp. 13–14, 3 refs. Experiments in 1942 showed that a dust of derris or cubé powder (4 per cent. rotenone), white lubricating oil and pyrophyllite (13 : 4 : 83), applied to apple trees five times at intervals of 10 days during the period of emergence of *Rhagoletis pomonella*, Walsh, and a spray of ½ lb. lead arsenate, 2½ lb. cubé powder (5 per cent. rotenone) and 1 U.S. quart summer oil per 100 U.S. gals. spray, applied four times at intervals of 10–12 days during the same period, in orchards in eastern New York reduced the percentage infestation to 0·16–0·27 and 4·2–24·3, respectively, as compared with 20–30 and 90–100 in 1941, when no treatment was given. Lead and arsenical residues on the fruit at harvest were above the legal tolerance in the sprayed orchard.

WHEELER (E. H.). **Experiments with Milky Disease for the natural Control of the Japanese Beetle in New York,** pp. 14–17. To determine whether *Bacillus popilliae* is capable of becoming a significant factor in the control of *Popillia japonica*, Newm., in New York [*cf.* **30** 568], plots in lawns showing an average infestation of 23·7 larvae per sq. ft. were inoculated by spot applications of dust containing 1,000, 3,000 or 9,000 million spores [*cf.* **31** 243], either dry or stirred into ½ U.S. pint water, at 5-foot intervals during the last week of May 1940. Population counts made just before adult emergence in 1941 and 1942 showed average populations of 5 and 7 per sq. ft. in treated ground and 8 and 10 in neighbouring untreated plots, the percentage of diseased individuals

being 21, 41, 0·5 and 12 respectively. The results obtained did not indicate any significant differences in effectiveness between dosages or between the two methods of application. On 24th August and 17th–18th November 1942, the average numbers of larvae per sq. ft. were 29·9 and 13·7 in untreated and 20·6 and 7·7 in treated plots, with 1, 7, 4 and 12 per cent. diseased, respectively. It is concluded that *B. popilliae* has become established and possesses considerable spreading power [*cf.* **31** 244], since it was probably not present in the untreated plots before the experiment. In one instance, spread over a distance of 160 ft. could not have been due to migration of infected larvae. At least seven counties in the State as well as New York City are now seriously infested with *P. japonica*, and more than 350 acres have been inoculated with the spores of *B. popilliae* during the last three years, in addition to 1,635 acres on government reservations.

Harman (S. W.). **An Improvement in the nonresidue Apple Spray Schedule,** pp. 17–18, 1 ref. Ferric dimethyl dithiocarbamate is a new fungicide sold as Fermate and has been reported to be as effective as mild sulphur fungicides in controlling apple scab. In field tests in 1942, its addition at the rate of ½ or 1 lb. per 100 U.S. gals. to sprays of ½ per cent. summer oil and nicotine sulphate (Black Leaf 40) or fixed nicotine (Black Leaf 155) applied seven times for the control of the codling moth [*Cydia pomonella*, L.] on apple did not reduce the effectiveness of the insecticides or damage the trees. To prevent the formation of an objectionable residue on the fruit at harvest, it was necessary to use an efficient spreading agent.

Glasgow (H.). **Substitute for Mercury Salts in Cabbage Maggot Control,** pp. 18–20. The results are given of tests of aqueous suspensions or solutions of nearly 40 possible substitutes for mercuric or mercurous chloride against *Hylemyia brassicae*, Bch., on cabbage and related crops. The few that were at all effective were very inferior to the mercurials and are not considered promising. Reduction of the concentration of mercuric or mercurous chloride from 1 : 1,200 to 1 : 2,400 caused little reduction in control, but if such low concentrations are used, greater care must be taken in their application.

Chapman (P. J.) & Greenwood (D. E.). **A new Apple Leafroller,** pp. 20–22, 1 ref. *Pseudexentera mali*, Freeman [*cf.* **31** 214], which is native to North America and has probably been present for many years on apple, its only known food-plant, in the north-eastern United States and the adjoining provinces of Canada, caused extensive leaf injury in one orchard in New York in 1941. In 1942, emergence began on 9th April and continued for about two weeks. Eggs were first commonly found on 14th April, and nearly all had hatched when the buds had reached the full delayed-dormant stage. The larvae feed primarily on the leaves, but occasionally attack the fruit ; they drop to the ground to pupate in late May or early June [*cf. loc. cit.*]. Ways of distinguishing the larvae from those of *Tortrix* (*Archips*) *argyrospila*, Wlk., are given. In 1941, sprays containing 3 per cent. oil, paraffinic, intermediate or naphthenic in type, emulsified with blood albumin and applied at the early delayed dormant stage against *Lygidea mendax*, Reut., gave approximately 99 per cent. control of the eggs of *P. mali*.

Hartzell (F. Z.). **Tests of modified Mixtures for the Control of Bud Moth on Apple,** pp. 23–26, 1 fig. **New Phases of Rosy Apple Aphid Control,** pp. 26–30, 1 fig. In the first of these papers, the author describes investigations in 1942 on the possibility of reducing the quantity of oil in the standard dormant sprays of dinitro-ortho-cresol against *Spilonota ocellana*, Schiff., on apple [*cf.* **30** 575]. All quantities given are amounts of actual toxicant per 100 U.S. gals. spray mixture. Sprays containing 19·2 oz. dinitro-o-cresol alone or 12·8 oz. with 1, 2 or 3 U.S. gals. oil, or a preparation (Elgetol) of sodium dinitro-o-cresylate (20·6 oz. dinitro-o-cresol alone or 13·8 oz. with 1 U.S. gal. oil), applied at the dormant stage, all gave over 96 per cent. control, but 19·2 oz. dinitro-o-cyclohexylphenol alone or 12·8 oz. with 1 U.S. gal. oil was much less

effective. Reducing the quantity of oil from 3 to 1 U.S. gal. had practically no effect on control, and powdered dinitro-cresol was almost as effective as sodium dinitro-cresylate containing the same quantity of the cresol, with or without oil. Dinitro-cresol (19·2 oz.) without oil gave almost as good control at the green-tip stage as at the dormant stage and did not cause bud injury. Sprays of nicotine sulphate (Black Leaf 40) and fixed nicotine (Black Leaf 155), applied at the green tip and delayed-dormant stages, were more effective at the latter, when nicotine sulphate (6·4 oz. nicotine), with 2½ U.S. gals. lime-sulphur, and 10·4 oz. fixed nicotine gave 92·2 and 92·6 per cent. control, and the addition of lubricating oil to either form of nicotine appeared to decrease its efficiency.

In similar tests against the eggs of *Anuraphis roseus*, Baker, on apple, described in the second paper, dinitro-o-cyclohexylphenol, dinitro-o-cresol and sodium dinitro-o-cresylate appeared to be highly and about equally toxic at the dormant stage, doubling the concentrations did not materially increase effectiveness, and the addition of 1 U.S. gal. oil to 6·4 or 12·8 oz. of the phenol or 1 or 3 U.S. gals. to the same quantities of the cresol had practically no effect. The cresol was in most cases more effective with sodium lauryl sulphate than alone and rather more effective with this compound than with oil. Both the cresol (12·8 oz.) and the cresylate (13·8 oz. cresol), applied at the green tip stage without oil, were very effective and did not injure the buds. Nicotine sulphate (6·4 oz. nicotine) with 2½ U.S. gals. lime-sulphur applied at the early delayed-dormant stage was as effective as the dinitro insecticides applied earlier.

Mendall (S. C.) & Avens (A. W.). **Summer Oil-Nicotine Sprays for Oriental Fruit Moth Control on Quinces,** pp. 30–33, 1 graph, 1 ref. In further experiments on the control of the eggs of *Cydia* (*Grapholitha*) *molesta*, Busck, on quince with sprays of nicotine and summer oil [*cf.* **30** 571], the three oils used showed figures for viscosity in seconds Saybolt, unsulphonated residue (per cent.), gravity (A.P.I. at 60°F.) and aniline point (°C.) of 61, 69 and 64, 94, 96 and 88, 29, 37 and 36, and 86, 104 and 99, respectively. Nine cover sprays were applied between 29th June and 21st September in a heavily infested orchard, and the effectiveness of each spray mixture is expressed by two figures showing its estimated percentage efficiency based on infestations of twigs on 11th August and of fruits on 14th October. When the three oils were emulsified with blood albumin and applied at the rate of 2 quarts per 100 gals. without nicotine, they showed efficiencies of 0 and 0, 73 and 66·7, and 75 and 65, respectively; the first left relatively little residue on the leaves after 10 days, but the others showed considerable oil residues ten days after each treatment and a cumulative increase in the total oil deposited as the season progressed. Sprays containing 1 U.S. pint nicotine sulphate (Black Leaf 40) with potash fish-oil soap or 4 lb. fixed nicotine (Black Leaf 155) per 100 U.S. gals. water showed efficiencies of 51·3 and 72·2 and 36·8 and 52·6, respectively, and one containing 2 quarts of the third oil and 1 pint nicotine sulphate per 100 gals. showed 84·5 and 85.

Carruth (L. A.). **An alternative Insecticide for European Corn Borer Control,** pp. 33–36. Owing to the shortage of rotenone-bearing materials and the fact that dual-fixed nicotine is no longer being manufactured in the United States, experiments were carried out in 1942 with Black Leaf 155 (14 per cent. fixed nicotine) for the control of *Pyrausta nubilalis*, Hb., on sweet maize. When applied to early sweet maize four times at intervals of 5 days, beginning soon after the first eggs had hatched, at the rate of about 175 U.S. gals. per acre, sprays containing 4 lb. derris (5 per cent. rotenone) with a spreader and sticker, 2 lb. Black Leaf 155 with 2 U.S. quarts summer oil and 2 oz. actual blood albumin [*cf.* **30** 569], 3 lb. Black Leaf 155 with 1 U.S. pint summer oil (to increase deposit), and 2 U.S. quarts summer oil with 2 oz. blood albumin, each per 100 U.S. gals. spray, reduced the number of larvae per 100 plants from 676 to 46, 262, 244 and 500, respectively, and the percentage of unsaleable ears from 42 to 7·7, 12·2, 11·5 and 30. The difference between the two nicotine

sprays was not significant, but the first is the cheaper. Since oil alone gave practically no control, it may be possible to eliminate it from the nicotine sprays. Further tests showed that Black Leaf 155 would apparently give satisfactory control if applied as an undiluted dust at the rate of 10–12 lb. per acre per application, but it does not flow freely and uniformly from the types of equipment used commercially. When diluted with walnut-shell flour to give 4 per cent. nicotine and applied at a correspondingly higher rate it was almost equally effective; dusts prepared with talc or bentonite were somewhat less satisfactory, and the addition of sulphur to these did not appreciably improve their performance. Wood-flour, with talc to improve its physical properties, was also promising as a diluent.

Harman (S. W.). **Spreaders for Codling Moth Sprays on Apple,** pp. 36–38. In view of the desirability in spraying against the codling moth [*Cydia pomonella*, L.] on apple of using suitable spreaders in the correct amounts, so that good coverage on the fruits is obtained and unsightly residues are avoided, the results are given of tests in 1942 with several correctly prepared mixtures that were applied in four cover sprays against each generation, and did not hinder natural colouring or leave objectionable visible residues on the picked fruit. The most effective were 3 lb. Black Leaf 155 (fixed nicotine) with 1 U.S. quart oil, 2½ lb. derris (5 per cent. rotenone) with 1 U.S. quart oil, and 3 lb. lead arsenate with 3 lb. hydrated lime per 100 U.S. gals. spray, each with a commercial spreader, which reduced the number of superficial injuries per 100 apples from 24·1 to 3·8, 2·2 and 23·4 and the number of larvae per 100 apples from 126·6 to 1·5, 1·0 and 1·1, respectively. The arsenical spray left some visible residue. Recent tests have shown that a small amount of hydrated lime (1–2 lb. per 100 U.S. gals.) is essential to produce satisfactory coverage with arsenicals when spreaders such as soy-bean flour and skim-milk powder are used. It is also pointed out that excessive amounts of a spreading or emulsifying agent may cause undue run-off, tank foaming and reduced spray pressure; and that the practice of first adding the spreading agent to clear water in the spray tank tends to give more consistent results, as its full efficiency is then more likely to be realised.

Hervey (G. E. R.). **A Study of Rotenone-bearing Dusts for Cabbage Insect Control,** pp. 39–44, 2 figs. The results of tests in 1942 of dusts containing 1, 0·5 or 0·25 per cent. rotenone as derris or cubé for the control of cabbage caterpillars are given and compared with those of similar experiments in previous years. The results have varied greatly from year to year, presumably owing to the fluctuation in numbers of the species involved, the number of applications and the rate of application. The two principal species are *Pieris rapae*, L., and *Plusia* (*Autographa*) *brassicae*, Ril., and the former is much more susceptible to rotenone than the latter. The results as a whole show little or no difference between derris and cubé, consistent differences in control between the three concentrations when the rate of application is 20–29 lb. per acre, and none between dusts containing 1 and 0·5 per cent. rotenone when the rate is higher. In 1939, 4, 3 and 2 applications of a dust containing 0·75 per cent. rotenone increased the yield by 22·9, 16·5 and 12·6 per cent., respectively. In 1942, the addition of 3 per cent. of various conditioning agents, including crude soy-bean oil and sodium oleyl sulphate, did not increase the toxicity of the dusts to *Pieris rapae* and appeared to decrease that of the weakest one, possibly owing to the inferior physical properties of the mixtures. It is concluded that a dust containing 0·5 per cent. rotenone is as effective as a more concentrated one if applied at approximately 35–40 lb. per acre, and that the best dust for use on cabbage consists of a mixture of ground rotenone-bearing root with an inert carrier, such as talc.

Hervey (G. E. R.) & Pearce (G. W.). **Diluents and Supplements for Lead Arsenate Dusts for Cabbage Worm Control,** pp. 44–46, 1 fig., 1 ref. In further tests in which dusts containing 25 per cent. lead arsenate or cryolite were

applied on 24th July and 7th and 26th August 1942 for the control of the imported cabbage worm [*Pieris rapae*, L.] on cabbage [*cf.* **31** 195], a dust of lead arsenate in Pyrax ABB [pyrophyllite] with 2 per cent. soy-bean oil was again the most effective ; there was little if any significant difference between dusts of lead arsenate and talc, alone or with 2 per cent. soy-bean oil or lubricating oil, and lead arsenate in hydrated lime gave poorer control than the other arsenical dusts. Cryolite, for which the carrier was talc, was inferior to lead arsenate with any carrier and was little better than no treatment.

Mundinger (F. G.). **Experiments with Dinitro Insecticides and Oil Sprays for the Control of Pear Psylla,** pp. 46–48. In tests of recently developed insecticides, including dinitro compounds and several newer brands of oil, against the pear psylla, *Psylla pyricola*, Först., in 1941 and 1942, proprietary preparations of sodium dinitro-o-cresylate diluted to give 13·8 or 27·5 oz. dinitro-o-cresol, with or without penetrants, per 100 U.S. gals. water or 13·8 oz. with 2 U.S. gals. paraffin oil (viscosity approximately 100 secs. Saybolt) and 1 oz. actual blood albumin per 100 U.S. gals., and 3 U.S. gals. of the same oil with 2 oz. blood albumin or 3 U.S. pints potash fish-oil soap per 100 U.S. gals. gave 94–98 per cent. control when applied at the dormant stage. The cresylates were especially toxic to the eggs and the oil had a greater residual effect on the nymphs, but the final control obtained appeared to be equal. Owing to the quicker kill obtained, the dinitro sprays may be preferable in unfavourable weather.

Brann jr. (J. L.) & Hamilton (D. W.). **A shortened, intensive Summer Spray Program for Apples in eastern New York : second Report,** pp. 48–51, 1 ref. In further tests in 1942 of a shortened spray schedule against the codling moth [*Cydia pomonella*, L.] and the apple maggot [*Rhagoletis pomonella*, Walsh] on apple in the Hudson Valley, the programme was largely the same as that used in 1941 [**30** 572], but six applications were made, a calyx spray on 11th May and the others on 19th May, 2nd–3rd, 12th–13th and 24th June and 3rd July. For the last treatment, some of the trees were sprayed with lead arsenate and Bordeaux mixture (0·75 : 3 : 100), with or without ¼ lb. skim-milk powder per 100 U.S. gals., and others with lead arsenate and lime or weaker Bordeaux mixture (0·5 : 1·5 : 100), but it is considered that it may be preferable to use lime rather than the stronger Bordeaux mixture to avoid some of the visible residue on the harvested fruit. Records showed that only 24 per cent. of the total number of moths taken in this orchard did not belong to the overwintered generation, as compared with 40 per cent. in one sprayed according to the general practice. At harvest, 97·87 per cent. of the apples of one variety and 96·52 per cent. of another were uninjured ; the lead residue on the first was below and that on the second slightly over the legal tolerance. Infestation by *R. pomonella* was not sufficient for any results to be obtained. It is pointed out that timing and thoroughness are of the utmost importance in this schedule ; that the orchard should be sufficiently isolated to reduce moth migration to a minimum ; that nicotine sulphate is added to the first and second cover sprays against the adults and should be applied on hot days if possible ; and that if large numbers of entries are observed at the beginning of the second generation, two applications of fixed nicotine at intervals of 7–10 days should be made.

Dean (R. W.). **Tank-mixed Oil Sprays for European Red Mite Control,** pp. 51–55, 2 refs. A petroleum oil spray, directed against the overwintering eggs, has proved the most effective single treatment for the control of *Paratetranychus pilosus*, C. & F., on apple [*cf.* **31** 3], but the choice of material and the time of application depend somewhat on the other pests to be controlled. Tar oils and combinations of tar and lubricating oils are relatively ineffective. Combinations of dinitro compounds and oil are more effective than oil alone at the dormant period but less dependable and safe at the green-tip and delayed-dormant stages ; they are the most effective means of controlling both mites and Aphids. Dinitro compounds alone do not control the mite.

Tables are given showing the efficiencies of six oils of different specifications when applied in different years as dormant, green-tip or delayed-dormant sprays at various concentrations and with various emulsifiers. Time of application is the most important factor affecting control of *P. pilosus*. In general, the later the application is made, the more effective it is, and where the mite is the principal pest, a lubricating-type oil emulsion should be applied at the green-tip or delayed-dormant stage. Nicotine sulphate, though safe, does not improve the control of the mite and should be used only when other pests are present. Increasing the concentration of oil increases the control, but above the recommended concentration of 3 per cent., the increase is not significant except during the dormant period, and there is no evidence that lower concentrations will give consistently satisfactory results. There is not much difference in the effectiveness of oils derived from different bases when applied at a concentration of 3 per cent. at the delayed-dormant stage, but at lower concentrations at the green-tip stage, more highly refined oils of paraffinic type gave consistently better control than oils with a naphthenic base. In dormant sprays, emulsifiers causing heavier oil deposits appear to give better control, but at the green-tip and delayed-dormant stages, when a fungicide is required for protection against early apple scab infection, the use of Bordeaux mixture (2 : 4 : 100) as both fungicide and emulsifier is recommended, since although it results in light oil deposits, it has given control as good as emulsions causing heavier deposits.

Taschenberg (E. F.). **Studies of Spray Supplements for Grape Berry Moth Control,** pp. 55–57. During 1941 and 1942 a preliminary study was made of spreaders and adhesives for the sprays of calcium arsenate and Bordeaux mixture used against *Polychrosis viteana*, Clem., on vines [**30** 573]. The sprays were applied at the rate of 225 U.S. gals. per acre, twice against the first generation and once against the second, and followed by uniform sprays of fixed nicotine with a spreader. A resin fish-oil soap has been most commonly used as a supplement [*loc. cit.*], but is expensive and causes excessive foaming in the spray tank. A summer oil (Orthol K) gave better results in both years, but the differences were probably not significant and the coverage was blotchy; the addition to the oil of Vatsol OS [a sodium alkyl naphthalene sulphonate] improved control and gave more even spreading. Other summer oils and a self-emulsifying vegetable oil gave similar results and did not cause foaming, but they produced objectionable visible residues and probably an arsenical deposit in excess of the tolerance for grapes intended for table use, and all but the vegetable oil, which is more expensive than the fish-oil soap, marred the bloom on the fruit. The most satisfactory spray programme now available appears to consist of two applications of an arsenical, with 2½ lb. resin fish-oil soap or 2 U.S. quarts Orthol K per 100 U.S. gals., followed by two applications of fixed nicotine with a spreader.

Chapman (P. J.), Pearce (G. W.) & Avens (A. W.). **Influence of Temperature and Rainfall on the Performance of Oil Sprays,** pp. 57–59, 1 ref. An account is given of tests to determine the influence of the weather during and immediately after the application of oil sprays on the deposit and insecticidal efficiency of the oil. Branches bearing egg-masses of *Tortrix* (*Archips*) *argyrospila*, Wlk., were sprayed with the minimum concentration of oil required to kill the eggs under ordinary conditions. Varying the temperature of the air from 42 to 78°F. and that of the spray water from 40 to 70° appeared to have no significant effect on oil deposit or insecticidal action, and neither was reduced when the spray was applied to wet bark. With air and spray temperatures of 68 and 50°, artificial conditions simulating 0·1, 0·5 and 2 ins. rainfall 5 minutes after spraying reduced the deposit from 1·11 to 0·81, 0·33 and 0·28 mg. per sq. in. and the percentage control from 99·4 to 78, 16·9 and 7·4, respectively, but the same amount of rain 25 minutes later, when the spray was just dry, resulted in deposits of 1·37, 1·11 and 0·98 mg. per sq. in. and 97·5, 94 and 98·6 per cent.

control ; the corresponding figures for 0·5 and 2 ins. rain 24 hours after spraying were 1·03 and 1·32 and 99·3 and 97·5. These results confirm the general opinion that some of the deposit is lost if rain occurs before it is dry, but not afterwards.

Hamilton (D. W.). **Notes on the Cherry Leafminer,** pp. 59–61. *Profenusa canadensis*, Marl. (*collaris*, McG.), which was first recorded in New York State in 1910, feeds chiefly on hawthorn (*Crataegus* spp.), but also attacks the leaves of English morello cherries [*cf.* **4** 98 ; **21** 228] ; it seems to be generally distributed throughout the State, but is apparently controlled by natural enemies in most orchards, and severe damage has occurred only locally and sporadically. Between 1938 and 1942, however, infestation increased in the entire Hudson-Germantown cherry district, though no other variety of cherry was attacked. The adult sawflies leave the soil at the end of April and in the first half of May, and as many as 202 have emerged under a single cherry tree. Mating and oviposition begin within a few hours ; the eggs are deposited in the outer edges of the leaves and hatch in 5-10 days. The larvae mine in the leaves, which drop to the ground, and have usually matured and left them by 3rd June. When mature they enter the soil, where they pupate in the following spring.

A spray containing 1 U.S. pint aliphatic thiocyanates (24 per cent.) in an oil base, 4 U.S. quarts summer oil, 2 oz. blood albumin and 4 lb. cubé root (5 per cent. rotenone) per 100 U.S. gals., applied on 16th May, gave at least 84 per cent. control of the young larvae in their mines ; sprays containing pyrethrum extract, alone or with rotenone, were ineffective, and nicotine sulphate and oil, or aliphatic thiocyanates and oil without cubé gave very poor results. Soil treatment with dichlorethyl ether (½ oz. per sq. yd.) was ineffective against the pupae. Applications of nitrogenous fertilisers to infested orchards usually induce late leaf growth and may help to offset the loss of the original leaves. Hawthorn trees should be removed from the vicinity of isolated plantings of morello cherry.

Wheeler (E. H.). **Insecticides for Peachtree Borer Control,** pp. 62–63. Since the supply of ethylene dichloride is limited by war conditions and its safeness in emulsions applied to peach trees for the control of *Aegeria* (*Sanninoidea*) *exitiosa*, Say, is doubtful, experiments were carried out with two proprietary solutions of paradichlorobenzene in emulsible oil and a solution of 2 lb. paradichlorobenzene crystals in 1 U.S. gal. soy-bean oil emulsified with 1 U.S. pint potash fish-oil soap in 2 U.S. gals. water. Each stock emulsion was diluted with 7 parts water, and about 1½ U.S. pints diluted emulsion was applied to the lower trunk and the soil round the base of each tree on 16th or 17th September, after grass and weeds had been removed and the ground had been levelled. Earth was mounded round the tree immediately after treatment. Counts of surviving larvae during the last week of November showed that all the treatments gave 95-99 per cent. control (the differences being insignificant) without injuring the peach trees, which were 4–5 years old.

Harman (S. W.). **The Effect of Summer Sprays on San Jose Scale Control on Apple,** pp. 63–64. The effect on *Aspidiotus perniciosus*, Comst., of eight cover sprays, applied during June, July and August against the codling moth [*Cydia pomonella*, L.], was determined from the proportion of apples showing its presence at harvest on trees that had not received a dormant oil spray. The percentage of apples infested was 0·2–1·5 on trees that received lead arsenate in the first two cover sprays and nicotine with summer oil or pyrethrum with summer oil in the other six, 10 on those treated with lead arsenate in the first two and rotenone in the remainder, and 5·3 on those receiving the last schedule with the addition of oil in the third and fourth sprays. Untreated trees had 21·8 per cent. infested fruit and trees that were given only three or four lead arsenate sprays even more. Most of the infested apples on the oil-sprayed trees bore only single scales, but fruit on the others was often noticeably infested.

Muesebeck (C. F. W.). **Two new Species of *Allotropa* (Platygasteridae, Serphoidea) parasitic on the Comstock Mealybug.**—*Bull. Brooklyn ent. Soc.* **37** no. 5 pp. 170–173, 1 fig. Lancaster, Pa., 1943.

Descriptions are given of both sexes of *Allotropa burrelli*, sp. n., and *A. convexifrons*, sp. n., which are parasites of *Pseudococcus comstocki*, Kuw., in Japan. *A. burrelli* is one of the species that was introduced into the United States by the Bureau of Entomology [*cf. R.A.E.*, A **29** 425; **30** 590, 593] and liberated in areas infested by the mealybug, and is described from many examples reared in Virginia; material of the same form from *P. comstocki* in Japan has also been studied. *A. convexifrons*, which appears to have entered the United States accidentally, is described from material reared from samples of the mealybug collected in New Jersey in November 1938. It has also been reared from *P. comstocki* at Yokohama.

Barber (H. S.). **Some Synonymy in *Dermestes* (Coleoptera).**—*Bull. Brooklyn ent. Soc.* **37** no. 5 pp. 174–176. Lancaster, Pa., 1943.

The author's views as to the synonymy of *Dermestes ater*, DeG. (*cadaverinus*, F.) and *D. maculatus*, DeG. (*vulpinus*, F.) are the same as those of Lepesme [*R.A.E.*, A **28** 389] and he proposes the same new name (*olivieri*) for *D. ater*, Ol.

Holdsworth (R. P.). **Some Work on the White Pine Weevil.**—*J. For.* **41** no. 2 pp. 143–144. Washington, D.C., 1943.

From 1920 to 1942, an attempt was made to control *Pissodes strobi*, Peck, on white pine [*Pinus strobus*] in a forest in Massachusetts by the annual removal of all the infested tips that the operator could reach with a 16-ft. pole pruner. The numbers removed decreased from 1,413 in 1920 to 46 in 1941 and 26 in 1942, and, as the work was done in the same way each year, it is probable that the numbers that escaped discovery were annually proportionate to the numbers removed. The general trend in these numbers was downward, but it was interrupted by four rises in infestation with peaks of 747 in 1929, 712 in 1932, 552 in 1936 and 493 in 1939. The susceptibility of the forest to infestation probably increased after 1938, when a hurricane brought down most of the trees over 50 years old.

Edwards (W. H.). **Entomological Division.**—*Rep. Dep. Agric. Jamaica 1941–42* pp. 9–10. Kingston, 1942.

During the year ending March 1942, further distributions of the eggs, larvae and adults of the predacious beetles, *Plaesius javanus*, Erichson, and *Dactylosternum hydrophiloides*, Macl. [against *Cosmopolites sordidus*, Germ., on banana] were made in Jamaica [*cf. R.A.E.*, A **29** 445]. Field experiments in protecting *Citrus* from attack by the larvae of *Citrus* weevils [*Prepodes* spp.] by removing the soil from beneath the crown of the main roots [*cf.* **30** 168, etc.] continued to give satisfactory results, and in one locality good control was obtained by collecting large numbers of the adults and egg-masses of *P. vittatus*, L. *Icerya montserratensis*, Ril. & How., was observed on *Citrus* in one locality. The termites found during inspection of buildings were *Heterotermes convexinotatus*, Snyder, *Kalotermes* (*Cryptotermes*) *brevis*, Wlk., and *Coptotermes havilandi*, Hlmgr., which occurred 26, 9 and 5 times, respectively [*cf.* **30** 415].

Handford (R. H.) & Putnam (L. G.). **Progress Report on Grasshopper Bait Investigations, Canadian Prairies, 1942.**—[*Leafl.*] *Brandon Lab. Dep. Agric. Canada* no. 6, 16 pp. multigraph. Brandon, Man. [1943].

Tests of poison baits for grasshoppers [*cf. R.A.E.*, A **30** 493] were continued in Manitoba and Saskatchewan in 1942, mainly on *Melanoplus mexicanus*,

Sauss., and also on *M. bivittatus*, Say. The experimental methods were essentially the same as before, with minor improvements. Sodium-arsenite solution assaying 7·7 lb. As_2O_3 per gal. was used as the poison.

As in the previous tests, a bait of 50 lb. wheat bran, an equal volume of sawdust, 1 quart sodium-arsenite solution and 10 gals. water, used as the standard, proved to be one of the most effective. Dry " concentrate " bran-sawdust bait, prepared by spraying 1 quart sodium-arsenite solution on 25 lb. bran and three times the volume of sawdust [*cf.* **31** 95], applied at the rate of 10 lb. per acre, gave results at least as satisfactory. Flour-sawdust baits were as effective as the standard, but only under conditions of light soil and relatively sparse vegetation, when a ratio of flour to old sawdust of 1 : 27 proved to be even better than one of 1 : 13. The age of sawdust influenced the results, a bait of weathered sawdust (cut from white spruce 5–10 or more years before) giving significantly higher kills without flour than a bait of flour and new sawdust, while the latter gave higher average kills than a bait of new sawdust alone. However, baits of weathered sawdust alone would give results greatly inferior to the standard bait. Further work on the value of sawdust as a carrier under different conditions is considered necessary.

Baits containing 1 pint sodium-arsenite solution per 100 lb. were almost as effective as those containing 1 quart, which suggests that, in the case of a shortage of arsenicals, it might be justifiable to use not more than 1·5 pints. A crude calcium arsenite tested as a possible substitute contained 26 per cent. arsenic on the dry weight basis and nearly 40 per cent. moisture, so that 9·65 lb. was required for a bait containing the arsenic equivalent of 1 quart sodium-arsenite solution. It was somewhat less effective than sodium arsenite, but could be used as a substitute if it could be obtained in a form suitable for quick and uniform mixing. In tests of the length of time for which a bait remains effective, baits exposed for 5 or 8 days were almost as effective as fresh ones, but these experiments were made with *M. bivittatus*, which was generally found to show lower mortality than *M. mexicanus*.

A detailed comparison was made of the two experimental methods used, and it was found that the mortality in field cage tests was significantly higher than in plot tests. Both methods are considered suitable for further work and their practical merits are discussed at length.

DE LA PEÑA (F.). **Presente y futuro de la plaga de langosta en España.** [The present and future Status of the Locust Problem in Spain.]—*Publ. Serv. Lucha contra la Langosta* no. 16, 23 pp., 4 pls., 1 dg. map, 3 figs., 1 ref. Madrid, 1942.

As a result of the campaign against *Dociostaurus maroccanus*, Thnb., in Spain in 1939–40 [*R.A.E.*, A **29** 529], the area infested in the spring of 1941 was only about 68,000 acres as compared with nearly 396,000 in the spring of 1940. The chief methods of control used were spraying with sodium arsenite and the distribution of bran baits poisoned with sodium arsenate or arsenite ; sheet iron barriers were employed in a few areas, as a supplement to baits for the protection of cultivated plots. The rates of application averaged 26·7 gals. per acre for the spray and 36 lb. per acre of bait containing 2 per cent. sodium arsenite. The average cost of treatment by the two methods was 14·18 pesetas per acre, as compared with 19·64 in 1923, when sheet iron barriers and gasoline mixed with gas-oil were used. The area expected to be infested in the spring of 1942 was about 38,000 acres.

Supplementary information is given on the outbreak areas of *D. maroccanus* in Spain [*cf.* **26** 698 ; **29** 459], and it is considered that a permanent anti-locust organisation might be able to keep it under preventive control at an annual cost of 400,000 pesetas, whereas the annual expenditure has averaged not less

than 2 million pesetas in recent years and reached 5·5 million in 1939–40 [*cf.* **29** 529]. It is important that the trained personnel of the permanent organisation should carry out regular surveys of all the suspected areas, particularly during oviposition and hatching, and not rely on the voluntary reports of farmers and landowners.

MILES (H. W.). **Turnip Flea Beetles.**—*Agriculture* **50** no. 1 pp. 36–38, 1 pl. London, 1943.

The natural food-plants of the flea-beetles [*Phyllotreta* spp.] that often destroy the seedlings of cultivated crucifers in Britain are charlock [*Brassica sinapistrum*], wild radish [*Raphanus raphanistrum*], and allied plants. Charlock, which is a preferred food-plant, grows plentifully among spring cereals, and large populations of *Phyllotreta* may be built up on it. These are beneficial in destroying this and other weeds while they are available, but cereals are commonly followed by turnips, swedes or kale, and since the weed seedlings are destroyed during the preparation of the soil for sowing, the beetles find little food when they emerge from hibernation. They are present in numbers when the seedlings germinate and destroy them as soon as they appear above ground, or even enter cracks in the soil and attack them before they reach the surface. Losses are accentuated by drought, bright sunshine, and dry winds.

Protective measures comprise the destruction of wild food-plants near susceptible crops, and of crop residues and the weeds in hedge bottoms and on headlands in order to limit the available sites for hibernation. The period during which the seedlings are susceptible is reduced by inducing quick growth, and a fine tilth, which has the additional advantage of providing little shelter for the beetles, should therefore be prepared before sowing, which, if possible, should not be performed during drought. A seed-dressing comprising a solution of paradichlorobenzene and naphthalene in kerosene [*R.A.E.*, A **24** 688] is now available commercially ; it is used at the rate of 1–2 fl. oz. per pound of seed, which should be spread on sacking and left overnight to allow the excess kerosene to evaporate. Under good conditions, this treatment affords protection until the seedlings are no longer susceptible, but it may not do so when germination is delayed by drought or through early sowing on a wet, cold seed-bed. Repellent dusts containing naphthalene and insecticidal dusts containing nicotine or derris [*cf.* **23** 221] have been widely used in recent years and have given satisfactory results. Their effectiveness depends on proper timing ; an application before the seedlings are quite through the ground should be followed by others at intervals of 2–4 days until the " rough-leaf " stage is reached. Where delayed germination has reduced the effectiveness of seed dressing, extended protection can be given by an application of dust during the earlier stages of attack. If these dusts are not immediately available, some temporary protection can be obtained by the application of any dust, such as basic slag or ground limestone.

CORBET (A. S.) & TAMS (W. H. T.). **Notes on the Nomenclature of the Moths hitherto known as** *Ephestia kühniella* **Zeller, 1879 (Lepidoptera : Pyralidae) and** *Endrosis lactella* **(Schiffermüller & Denis, 1775) (Lepidoptera : Oecophoridae).**—*Entomologist* **76** p. 15. London, 1943.

The authors state that *Ephestia kuehniella*, Zell., and *Endrosis lactella*, Schiff., are synonyms of *Ephestia* (*Hyphantidium*) *sericaria*, Scott, and *Endrosis* (*Phalaena*) *sarcitrella*, L., respectively.

Evans (J. W.). **Orchard and Garden Mites and their Control.**—*Tasm. J. Agric.* **13** no. 4 pp. 140–142, 4 figs., 1 ref. Hobart, 1942. **Scale Insects.**—*T.c.* pp. 156–159, 2 figs.

In these two papers, notes are given on the appearance, bionomics and control of the mites and Coccids that are injurious to orchard and other crops in Tasmania ; all of the mites and most of the Coccids have been introduced. The food-plants of *Bryobia praetiosa*, Koch, include apple, almond, peach, plum, clover and grasses. The eggs are deposited singly on the lower surfaces of the leaves in early summer and in masses on the branches and round the buds of trees and on stones on the ground in late summer and autumn. They are attacked by the Coccinellid, *Scymnus vagans*, Blkb., which, however, does not exert effective control. The overwintered eggs hatch in mid-September and the adults appear about a month later ; there are two or three generations during the summer. The mites pierce the cells of the leaves and extract the sap, and severe infestation may result in premature leaf-fall. They are favoured by hot, dry weather, and damage is therefore most severe during late summer. *Paratetranychus pilosus*, C. & F. (*Metatetranychus ulmi*, auct.), which also attacks fruit trees and other plants, is more abundant on apple than *B. praetiosa*. The overwintering eggs are deposited in similar situations and hatch in September. Each female lays about 30 eggs, which in summer hatch in about a fortnight. There are probably three overlapping generations a year. The injury resembles that due to *B. praetiosa*, but is more serious, since heavy infestations are not confined to dry seasons. On apple, both species are controlled by red oil (1 : 20) applied just before the buds begin to swell in spring and by sprays containing white oil (1 or 2 per cent.) or lime-sulphur and a spreader in the summer ; white oil is more satisfactory against *P. pilosus* than lime-sulphur, which, however, is effective when applied at the pink and calyx stages, when few eggs are present.

Tetranychus telarius, L. (*urticae*, Koch) is most important in Tasmania on hops, vegetable crops and ornamental plants, and is a serious greenhouse pest, but it is often abundant on fruit trees. The adults overwinter in the soil and in cracks in the bark of trees, and the eggs that are laid in spring hatch in about three days. Development is completed in about 12 days, and the adults survive for about two weeks. Control during the winter is impossible. Summer treatment comprises spraying with lime-sulphur (2 per cent.) or white oil emulsion (1–2 per cent.) ; repeated application of superfine sulphur dust or spraying with a mixture containing 1 lb. glue in 8 gals. water also gives fair control. Syringing with water is beneficial to many plants in greenhouses.

Eriophyes pyri, Pgst. [*cf. R.A.E.*, A **23** 91] is especially injurious to pear, though it also attacks apple, and *E. tristriatus*, Nal., occurs on walnut, but is seldom injurious. *E. avellanae*, Nal., feeds on the developing buds of hazel and filbert [*Corylus*], causing them to become enlarged ; heavily infested trees produce few leaves and no nuts. These three species are effectively controlled by lime-sulphur (1 : 10) applied in spring just before the buds open or in autumn just after the leaves have fallen. *Phyllocoptes lycopersici*, Massee [*cf.* **24** 211] attacks tomatos grown under glass. The interval between successive plantings of this crop in infested houses should be as long as possible and the plants should be dusted with sulphur.

Coccids are in general less injurious in Tasmania than on the warmer mainland of Australia. Only two native species, *Pseudococcus* (*Dactylopius*) *albizziae*, Mask., which attacks wattle [*Acacia*], and *Eriococcus coriaceus*, Mask., which attacks *Eucalyptus*, are of any economic importance, and they are usually controlled by natural enemies.

Coccus hesperidum, L., and *Lecanium persicae*, F., have one generation a year. The former infests ornamental plants, shrubs and fruit trees, and is common in glasshouses, and the latter commonly attacks vines, bush fruits and *Wistaria*,

but is usually less abundant and seldom very injurious. *Saissetia coffeae*, Wlk. (*hemisphaerica*, Targ.) and *S. oleae*, Bern., occasionally occur on *Citrus* and ornamental evergreens in the warmer parts of the State; the former is especially common on ornamental ferns and the latter on lemon. These four species overwinter in a half-developed condition and excrete honey-dew on which sooty moulds develop. They are controlled by spraying with white oil, preferably during December or January; oil should not be applied to evergreens in full sunlight.

Aspidiotus perniciosus, Comst., *A. rapax*, Comst. (*camelliae*, auct.), *A. ostreaeformis*, Curt., and *Lepidosaphes ulmi*, L., are all principally associated with apple, though occurring on other plants. As a result of improved control, *A. perniciosus*, which at one time was the most serious orchard pest, is now seldom present in commercial orchards. It overwinters when half-grown, and the adults generally appear in October. The development period occupies about seven weeks in summer, and there are several generations a year. The best control is afforded by dormant sprays of red oil emulsion (1 : 20), though lime-sulphur (1 : 9) can also be used. *A. rapax* occasionally occurs on apple; it is controlled on deciduous plants by the sprays recommended against *A. perniciosus* and on evergreens by white oil sprays applied during spring and summer. *A. ostreaeformis* is less injurious on apple than either *A. perniciosus* or *A. rapax*. *L. ulmi*, which chiefly attacks neglected apple trees, overwinters in the egg stage, covered by the parent scale, and has only one generation a year. Effective control is given by a dormant spray containing tar distillate (5 per cent.), or one containing white oil emulsion (2 per cent.) applied in late October.

Aulacaspis rosae, Bch., infests rose, blackberry, loganberry and raspberry and is controlled by white oil applied alone or with the addition of nicotine sulphate. *Aonidiella aurantii*, Mask., is of minor importance owing to the infrequent occurrence of *Citrus*. Mealybugs are not very injurious on out-door plants, but a species of *Pseudococcus* is common on vines and other plants in glasshouses, on which its honey-dew provides a medium for sooty moulds. It can be controlled by a spray containing white oil (1 per cent.) and nicotine sulphate, and heavily infested vines should be scrubbed during winter with a soft brush dipped in weak kerosene emulsion.

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Wille (J. E.). **Resumen de las diferentes labores ejecutadas en el Perú para combatir insectos dañinos por el " método biológico."** [Summary of the Work carried out on the Biological Control of Insect Pests in Peru.]—*Proc. 6th Pacif. Sci. Congr. 1939* **4** pp. 369–371. Berkeley, Calif., 1940. [Recd. 1943.] [*Cf. R.A.E.*, A **31** 24, etc.]

King (E. W.). **A taxonomic Distinction between** *Cyllene robiniae* **(Forst.) and** *Cyllene caryae* **Gahan.**—*Amer. midl. Nat.* **29** no. 1 pp. 180–182, 3 figs., 1 ref. Notre Dame, Ind., 1943.

Austen (E. E.) & Hughes (A. W. McK.). **Clothes Moths and House Moths. Their Life-history, Habits and Control.**—*Econ. Ser. Brit. Mus.* (*Nat. Hist.*) no. 14, 3rd edn. revd. by A. W. McK. Hughes & H. Stringer, 40 pp., 19 figs., 31 refs. London, 1942. Price 6*d.* [*Cf. R.A.E.*, A **21** 1; **24** 48.]

Graham (J. J. T.). **Pyrethrin Determination. The Determination of Pyrethrins in Mixtures of Pyrethrum Powder with other insecticidal Ingredients and various Diluents.**—*Soap* **18** no. 11 pp. 95, 97, 99, 1 ref. New York, N.Y., 1942.

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CONTENTS.

	PAGE
AFRICA, SOUTH: A Fungous Disease of *Plutella maculipennis*	296
AFRICA, SOUTH: Protection of Tobacco Seed Beds from Ants in S. Rhodesia	298
AFRICA, WEST: The Bionomics of *Dysdercus superstitiosus* in Belgian Congo	297
AFRICA, WEST: *Tarsonemus latus* on Cotton, etc., in Belgian Congo ...	297
AFRICA, WEST: A Sphingid on *Cinchona* in Belgian Congo	298
AMERICA, TROPICAL: The Collection of predacious Coccinellids in Trinidad and Brazil	289
AUSTRALIA: Injurious Mites and Coccids in Tasmania	311
BRAZIL: The Collection of Parasites of *Diatraea saccharalis* (*Title only*)	312
BRITISH ISLES: *Argyresthia conjugella* and other Lepidoptera on Apple in Ireland	283
BRITISH ISLES: A mobile Trap for Flea-beetles	283
BRITISH ISLES: The Use of Mercurous Chloride against *Hylemyia antiqua*	284
BRITISH ISLES: The Larvae of *Acidia heraclei* and *Adelura apii* and a Fungus associated with them	284
BRITISH ISLES: Turnip Flea-beetles and their Control	310
BURMA: Investigations on a Parasite of *Xyleutes ceramicus*	295
CANADA: Work on Forest Pests in Quebec in 1940–41	284
CANADA: Tests of Baits for Grasshoppers	308
CEYLON: Effect of Plucking on Infestation of Tea by *Xyleborus*	296
CHILE: The Introduction of Natural Enemies of Insect Pests	290
HAWAII: Control of *Megamelus proserpina* by an introduced Capsid ...	289
INDIA: Entomological Work connected with Lac Cultivation in 1941–42	294
INDO-CHINA: Insects attacking *Eugenia operculata*	294
JAPAN: A Review of Work on Biological Control	291
JAPAN: New Parasites of *Pseudococcus comstocki*	308

CONTENTS—*cont.*

	PAGE
JAPANESE MANDATED IS.: A Survey of Insect Pests	292
PERU: Work on the Biological Control of Insect Pests (*Title only*) ...	312
PHILIPPINES: A Survey of Work on Entomology	292
SPAIN: The Status of the Locust Problem	309
SWEDEN: The Bionomics and Control of *Tinea secalella*	281
SWEDEN: Records of Pests in 1937	282
SWEDEN: *Diarthronomyia chrysanthemi* and its Control	282
U.S.A.: Insect Pests of stored Rice and their Control	273
U.S.A.: Oil Treatment of Maize Ears against *Heliothis armigera*	274
U.S.A.: Insecticides against *Pyrausta nubilalis* on Sweet Maize	274
U.S.A.: Flights of Aster Leafhoppers as determined by a Light-trap ...	275
U.S.A.: Purple-top Wilt of Potatoes caused by Aster-yellows Virus ...	275
U.S.A.: Effect of Site of Inoculation on Curly-top in Tobacco	275
U.S.A.: Different Vectors for Varieties of a Plant Virus	276
U.S.A.: Distribution of *Beauveria bassiana* on Elm Insects	276
U.S.A.: Noctuids taken in Light-traps in Kansas and Nebraska... ...	277
U.S.A.: Hibernation of *Heliothis armigera*	278
U.S.A.: Survival of *Pyrausta nubilalis* on resistant and susceptible Maize	279
U.S.A.: The Importance and Control of *Empoasca fabae* on Lucerne ...	279
U.S.A.: Observations on the Bionomics of *Sinea diadema*...	280
U.S.A.: Pests intercepted in Quarantine in 1940–41	280
U.S.A.: Electrical Conductivities of Sorghum Juices in Relation to *Blissus leucopterus*	285
U.S.A.: Insect Pests in Oklahoma in 1941	285
U.S.A.: The Pests of Cotton in California	286
U.S.A.: Colonisation of imported Parasites of *Pyrausta nubilalis* ...	288
U.S.A.: Recent Introductions of Parasites against *Diatraea saccharalis*	291
U.S.A.: The Biology of *Merodon equestris* in the Pacific Northwest ...	298
U.S.A.: Tests of Sprays and Dusts against *Empoasca fabae*	299
U.S.A.: Work on Control of Insect Pests in New York	300
U.S.A.: New Introduced Parasites of *Pseudococcus comstocki*	308
U.S.A.: Work against *Pissodes strobi* in Massachusetts	308
U.S.A.: Characters distinguishing *Cyllene robiniae* and *C. caryae* (*Title only*)	312
WEST INDIES: Work on Insect Pests in Jamaica in 1941–42	308
A Method of physiological Assay of Pyrethrum Extracts	274
Adsorption of Chloropicrin and other Fumigants by the Soil	276
The Toxicity of Tartar Emetic to *Anastrepha ludens*	276
Susceptibility to Calcium Arsenate of *Laphygma eridania* on different Plants	277
Methods of separating Insects from Samples of Food or Drugs	280
Determination of Copper on Apples when Lead Arsenate is present ...	280
Biological Studies of Parasites employed in Biological Control	292
The Confusion of two Species of *Hypera*	292
The Value of Laboratory Propagation of Parasites	293
Factors relating to Colonisation of Parasites...	293
The Distribution of Virus Diseases of Sugar-cane and *Musa* spp.	294
Spraying Equipment for Pest Control	299
The Synonymy of some Species of *Dermestes*...	308
Earlier Names for *Ephestia kuehniella* and *Endrosis lactella*	310
Clothes Moths and their Control (*Title only*)	312
Determination of Pyrethrins in Mixtures containing Pyrethrum (*Title only*)	312

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